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THE VIRGINIA JOURNAL OF SCIENCE

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CONTENTS

	Pages
Foreword — Marcellus H. Stow	1
Indians of Virginia 350 Years Ago—Bruce D. Reynolds	3
Geologic Ancestry of the York–James Peninsula — Arthur Bevan	19
Seventeenth Century Science in Old Virginia — Ivey F. Lewis	35
History of Virginia's Commercial Fisheries — J. L. McHugh and Robert S. Bailey	42
Physicians at Early Jamestown — Sidney S. Negus	65
News and Notes	74

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THE VIRGINIA JOURNAL OF SCIENCE

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Foreword

The Virginia Academy of Science takes particular pride in the five purposes for which it exists, two of which are: "To encourage scientific research in Virginia and to arouse public interest in science" and "To render public service in scientific matters."

When it became known that the State of Virginia would publicly recognize the 350th anniversary of the settlement of Jamestown, the officers of the Academy saw a unique opportunity to "arouse public interest in science" and to "render public service in scientific matters."

It was decided to publish a special issue of the Virginia Journal of Science in which would be included chapters describing certain basic aspects of the scientific and cultural development of Virginia.

It was thought appropriate to include one chapter on the race of mankind that inhabited Virginia before the arrival of another race to establish the settlement at Jamestown. Hence a section on Indians has been prepared by Dr. Bruce D. Reynolds, Professor of Biology, University of Virginia.

Of fundamental importance in the history of any state or nation is the composition and structure of its rocks; an article on the Geology of Virginia has been prepared by Dr. Arthur Bevan, one time State Geologist of Virginia and recently retired as Principal Geologist, Illinois State Geological Survey.

It was recognized that all aspects of science could not be included in a single number of a journal; therefore a chapter on the History of Science in 17th Century Virginia has been prepared by Dr. Ivey F. Lewis, formerly Head of the Miller School of Biology and recently retired as Dean of the College, University of Virginia.

Probably the first and most obvious source of food for the settlers was from the waters of the ocean and tidal streams. Since those days seafood has been an important part of the State's economy and much scientific study has been devoted to shell fish and fin fish. The article on Fisheries has been written by Dr. John L. McHugh, Director, Virginia

Fisheries Laboratory, and Mr. Robert S. Bailey also of the Virginia Fisheries Laboratory.

The scientific and economic status of a nation bears a direct and distinct relationship to the health of its inhabitants. Virginia has always been a leader in the development of medical sciences; hence a chapter on this topic was included in this Commemorative Issue of the Journal. It was prepared by Dr. Sidney S. Negus, Professor of Biochemistry, Medical College of Virginia.

The attractive design for the cover was prepared by Mr. Horace Day, Professor of Art, Mary Baldwin College.

We are confident that readers of this Jamestown Festival number of the Virginia Journal of Science will appreciate the time and energy the above Virginians put into the preparation of these articles. Members of the Virginia Academy of Science wish to express sincere thanks to the authors and to Mr. Day.

Particular expression of thanks and appreciation are due Dr. Horton H. Hobbs, Professor of Biology, University of Virginia, and Editor, Virginia Journal of Science, and Miss Mary E. Humphreys, Associate Professor of Biology, Mary Baldwin College, Associate Editor, who assumed the additional work and responsibility of editing and making all arrangements for the Commemorative Issue.

MARCELLUS H. STOW, *Chairman*
Jamestown Festival Committee,
Virginia Academy of Science

November 20, 1956
Lexington, Virginia

Indians of Virginia 350 Years Ago

BRUCE D. REYNOLDS

University of Virginia

America had been discovered by primitive man long before Columbus sailed westward. No evidence uncovered so far indicates that man evolved from the prehuman condition to modern man in the Western Hemisphere, but we do have proof that man inhabited this country during the Pleistocene period.

At Folsom, New Mexico, and later at Collins, Colorado, manmade artifacts were found beneath the bones of an extinct species of bison. Near Clovis, New Mexico, these so-called "Folsom" points have been found with the skull of a mammoth. The age of these characteristic darts is estimated to be from 10,000 to 20,000 years. Folsom points have been found extensively over the United States, and over one hundred have been reported from Virginia.

In the October, 1956, issue of the National Geographic Magazine, Carl F. Miller describes diggings in Russell Cave in northeastern Alabama. These findings indicate a continuous human occupancy for the past 8,000 years. The excavations have not been completed, but there is the possibility that the time of its habitation will exceed 15,000 years.

The Richmond Times-Dispatch for October 14, 1956, page 32-A, carries two articles dealing with early man in America. One states that a spearhead found with a human skeleton indicates that: "The four Turin, Iowa, skeletons were buried about 4,500 B. C." The other article informs us that: "A Texas anthropologist says radiocarbon tests show a woman's skull found near Midland, Tex., three years ago apparently is 20,000 years old-the oldest human remains ever found in the Western Hemisphere." The skull is "not unlike that of the modern American Indian."

A few years ago I was impressed by a collection of copper artifacts in a Madison, Wisconsin, museum. They were so superior to any I had seen before that I inquired, *what* Indians made them? The reply "*early,*" prompted me to ask "How long ago?" The reply was "Over 1500 years; a carbon 14 test is now being made to establish the age." When this test was completed it showed the objects to be 5,600 years old. Thus, this culture was coexistent with early Babylonian culture.

If the Indians did not develop in America, from whence did they come? According to Ales Hrdlicka some of the Tibetan tribes along

the southern slopes of the Himalayas resemble the American Indian so closely that if they were transported to America nobody could possibly take them for anything but Indians. Martin, Quimby, and Collier (1946: 16) state "The American Indians probably represent several different racial types." Hrdlicka has shown that several migrations came over from Asia by way of the Behring Straits. Such migrations probably took place over a long period of time. This does not preclude the possibility of water-borne migrations at other places.

Several years ago a number of people became intrigued with the idea that the American Indians were a lost tribe of Israel. In his book, published in 1853, McIntosh develops the thesis that Magog, the second son of Japheth, was the progenitor of the American Indians. He says these Magogites were called Scythians by the Greeks. Since recent discoveries have pushed back the time table this position is no longer tenable.

As in other parts of the world, human populations in America were subject to change. It is not at all unusual to find two or more types of artifacts in the same locality. On one site near Charlottesville, Virginia, we have found artifacts representing four distinct cultures, one of which is extremely primitive.

Many village sites have been found since the Indians left the region and new ones are being added to the list each year. This is not surprising in view of the fact that during colonial times neither Indians nor whites were particularly interested in *vanished* tribes.

At the beginning of the seventeenth century there were probably less than 1,000,000 Indians in America north of Mexico, or about 800,000 in continental United States. Approximately 20,000 of these were in the confines of present Virginia. In the Coastal Plains (Tidewater) area there were close to 9,000 belonging to the Algonquian stock. These belonged to the powerful Powhatan Confederation, which was made up of over thirty tribes, all but six of which had been brought together by Powhatan himself. Powhatan's father had started the Confederation by bringing under his control six of the Algonquian tribes. According to Strachey (1849) they called their land "Isenacommacach." Siouans occupied most of the Piedmont and Blue Ridge Mountains area. In the northern part of this region were the Manahoacs, consisting of at least eight tribes and comprising perhaps 1,000 persons. In the central and southern region were the Monacans, made up of five or more tribes and comprising about 2,500. From Batts Journal (1671) we learn that another group of Sioux, the Monetons, were in the western part of the State and in West Virginia on the New River. Apparently one tribe of them was called the Kanawhas. Their number is estimated to have been 500. Several of their village sites and burial

grounds have been studied by the author and others. In the southeastern Piedmont were two tribes of Iroquoian stock, the Nottoways with about 1,500 people and the Meherrins with approximately 700. The Cherokees, also of Iroquoian stock, occupied the southwestern part of the State, as well as parts of the Carolinas, Georgia, Alabama, Tennessee, and Kentucky. This was one of the largest groups of Indians and it is estimated that there were 22,000 persons in it. In addition to these, various wandering tribes came into the Shenandoah Valley as well as other parts of the State.

To the south of Virginia were the Weapemeocs, Chowanocs, Tuscaroras, and others, while to the north were the Massawomeckes and Sasquesahanocks, the latter referred to as giants.

There are several reasons for thinking that the distribution of people as given above had not been that way for a long time. Strachey (1849) says of the Powhatan Indians that they "are conceived not to have inhabited here belowe much more than three hundred years." Lederer (1672) says of the Indians of the western part of the State they were "driven by an enemy from the northwest, and invited to sit down here by an oracle about four hundred years since, as they pretend: for the ancient inhabitants of Virginia were far more rude and barbarous, feeding only on raw flesh and fish, until these taught them to plant corn and shewed them the use of it." By a series of maps Bushnell (1934) shows that prior to the sixteenth century the Algonquians had migrated in from the north, the Siouans from the northwest, and the Iroquoians from the west.

Europeans may have sailed along the Virginia coast during the latter part of the fifteenth century and the early part of the sixteenth, but there is no evidence that they made any contact with the natives. It is possible that Francisco Gordillo and Pedro Quexos entered the Chesapeake Bay in 1521 while hunting for Indians to be sold into slavery.

About 1560 an Indian youth, who was the brother of a principal chief in the Chesapeake Bay region, was taken to Mexico by the Spaniards. It is not clear whether or not he was abducted by force. (During the sixteenth century a number of young Indians were captured to be used as interpreters.) This boy was baptized and given the name of Don Luis after his foster father, Luis de Velasco, Viceroy of Mexico. Subsequently he was sent to Spain and educated as a young nobleman. He came back to America and accompanied the three priests and six lay readers who attempted to establish a mission on the York River in 1570. Don Luis beguiled the Spaniards into withdrawing all force, even the ship, having convinced them that with his aid the Indians (his people) could easily be converted to Chris-

tianity. As soon as the ship had left Don Luis began making plans for the annihilation of the mission and within a few months participated in the murder of all except a youth, Alonso de Olmos, who had been adopted by a chief. The next year the Spaniards returned bringing supplies for the mission, but seeing Indians in priests vestments they became suspicious and did not land immediately. Later two Indians were captured and from them it was learned that the mission had been destroyed. In 1572, a punitive expedition was sent into the region. The land was invaded and many Indians were killed and captured and Alonso was rescued. He told of Don Luis' perfidy. One of the captured Indians was sent ashore with instructions to bring Don Luis back within three days, otherwise all of the captive Indians would be killed. When the three days were up and the emissary had not returned, all of the other prisoners were hanged from the yardarms of the ship.

At the Raleigh settlement in the nearby Albemarle Sound, numerous unpleasant encounters had taken place between the whites and Indians, and a considerable number of whites, including women and children, disappeared from the settlement on Roanoke Island between 1587 and 1590 without leaving a definite trace. Whether or not the Virginia Indians participated in these conflicts, they knew about them.

According to Brown (1890) Captain Bartholomew Gilbert and several companions were massacred in the Chesapeake Bay area in 1603. Retaliatory measures were taken by his comrades.

These unpleasant encounters between the Indians and Europeans give a background for better understanding the relationships between the natives and the Jamestown settlers.

When Bartholomew Gosnold and his immigrants, numbering a few over 100, first reached the Virginia coast and landed on Cape Henry they found the Indians hostile. An encounter ensued in which several on both sides were injured. The English then moved up the James River about fifty miles and settled at a place they called Jamestown. At first the Indians were friendly. Shortly after landing, Captains Newport and Smith with twenty men made an expedition up the James River to Powhatan (the present site of Richmond) to visit the principal chief. Before they returned trouble had developed at the settlement. Newport returned to England for supplies and more settlers.

Smith early showed his disposition for discoveries by taking a few men in a pinnace and going up the Chickahominy River. When the stream became small and their passage was barred by fallen trees, he left all but two of his companions with the boat and he, with two whites and two Indians, proceeded up the river in a canoe. When

further progress became difficult, he took an Indian guide and continued up the stream on foot. The men left with the canoe were killed by the Indians and ultimately, Smith and his guide were captured. Smith was bound and carried to several of the Indian villages there to be exhibited. This may have been because he was such an important captive, but it has been suggested that he was shown to see if the Indians could recognize him as the Englishman who led a raid against the village a few years earlier.

Of the 105 persons making up the first group to settle at Jamestown, only twelve were laborers and a very few were mechanics. The remainder were 'gentlemen of fortune'. Fifty, including Gosnold, died before autumn. The number of colonists remaining had been reduced to forty by the time Smith returned from seven weeks of captivity. For years our history books have carried an account of Smith's rescue from death by Powhatan's young daughter, Pocahontas. Not only did she save Smith's life, but through her, temporary friendship between the whites and Indians was established, and the Indians provided corn and other food that was so badly needed. Later Pocahontas informed the settlers of a proposed attack the Indians had planned and aided them in many other ways. Perhaps she saved the colony as well as Captain John Smith.

While Smith was in captivity the morale of the colonists was exceedingly low. Three attempts were made by certain members of the group to escape in the small ship and return to England. Captain Newport's return with supplies and 120 more settlers was just in time to thwart the third attempt and did much to re-establish order.

Smith made extensive explorations along both shores of the Chespeake Bay and up the rivers flowing into it. He made a map of the country, showing on it the location of the Indian villages. Through inquiries, he extended his discoveries far beyond the limits traveled and thus recorded the names and location of many tribes living west of the Coastal Plains area. His map is so well done that it still is a marvel of excellency.

Attention has been called to the fact that many of the first settlers were not well qualified to endure the rigors encountered. Inadequate plantings were made and entirely too much time was spent in looking for gold and other riches. Much of the food brought over moulded, rotted, or otherwise spoiled. This produced a continued dependency on the Indians for food. Corn (maize) was the principal food commodity. For this the whites traded glass beads, pieces of copper, and various baubles of little intrinsic value. In some cases the Indians demanded knives, swords, or guns. Sometimes force was used to obtain needed supplies. During the winter 1609-1610 food short-

age was so acute that at least one case of cannibalism is reported. The summer before one of the Indian villages had been attacked by the colonists, the buildings burned, the growing corn destroyed, and the chief's wife and two children captured and killed.

With such hostilities existing it is remarkable that the colony was able to survive, for Brownell (1854) estimates that 5,000 Indians lived within sixty miles of Jamestown.

In general, Indians were friendly towards the whites when they first made contact with them. Barlowe (1584) says of his first visit to Roanoke Island: "We were entertained with kindness and friendship and were given everything they could provide. We found these people gentle, loving, and faithful, lacking all guile and trickery." The next year, during the 1585 expedition, a silver cup was stolen from the English at an Indian village and was not restored on demand. Grenville ordered the whole town to be burned and the standing corn to be destroyed. The red man could not comprehend nor appreciate this kind of treatment. Suspicion, bitterness, and trickery occupied more and more of his thoughts and he did what he thought best to escape the inevitable.

The Aztecs and Incas to the south were organized into complex societies. The Indians in the United States were composed of about 600 national societies, each complete, many-sided, self-reliant. Upon contact with the white man this led to years of warfare and no yielding of the Indians to anything but the mere fact of being physically overwhelmed. Where the civilized Indian could accept his fate and make the adjustments which would enable him to survive, the semi-civilized one could make no compromise. The braver ones fought to the death or until their capacity to resist had been destroyed. Many tribes were completely wiped out, others moved to new territory, and a few accepted the miserable lands allotted them. Most of these hybridized with whites and negroes.

Robinson (1953) states: "When first establishing settlements in North America, the British government, like other Europeans, did not recognize the sovereign rights of the heathen natives and asserted a title to all the lands occupied by Indians, within the chartered limits of the British colonies." The lands were appropriated whenever and wherever force was sufficient to carry out wishes. The Indians' ability to resist these encroachments became lessened and they were restricted to smaller areas. After this stage of relative docility had been established, it was not unusual for outside tribes to raid the colonists. Hodge (1912) reports that "in 1675 some Conestoga, driven by the Iroquois from their country on the Susquehanna, entered Virginia and committed depredations. The Virginia tribes were accused of these acts

and several unauthorized expeditions were led against them by Nathaniel Bacon." On some of these occasions old men, women, and children were brutally slaughtered.

As pointed out above, the American Indians were composed of several racial groups. Those living in Virginia belonged either to the Algonquian, Siouan, or Iroquoian stocks. Various morphological differences existed between the different stocks, such as height, features, and color. At birth most Indians are lighter in color. With increasing age and exposure to the sun and other elements the skin becomes darker. In many cases the darkness was exaggerated by the accumulation of clay, soot, and dirt. In general they had excellent postures and it was very rare to see a cripple, or otherwise deformed Indian. This applies to the mental condition as well as to the physical. This trait was so marked that the early observers wondered if they deliberately destroyed the feeble. Perhaps nature takes care of that in a primitive society where the rigors of living take a heavy toll of the weak. The primitive Indian rarely had enough food or time to permit him to become obese. The face is described as ugly and severe. The high cheek bones, the large mouth with thickened lips, the large nose, aquiline in some, broad in others, the dark brown or black eyes, the straight black hair, the coppery red color — these are qualities we usually associate with the Indian.

The body hair was sparse, as was the facial hair of the men. Usually the beard was plucked out or cut off. Adair (1775) describes this process as follows: "Both sexes pluck all the hair off their bodies with a kind of tweezers made formally of clamshells." Exceptions to this rule are noted by Spelman (1884) who says that beards were worn by some priests, and by Lawson (1714) who mentions mustaches and whiskers seen among the Keyauwee.

The manner of wearing the head hair varied with the different tribes. Women usually allowed their hair to grow long except in time of mourning, when it might be cut off or just disheveled. The Powhatan unmarried girls had the front and sides cut close and allowed the rest of it to grow long and hang down their backs, tying it in a plait. The married women allowed all of their head hair to grow long. It was plaited and tied as was that of the unmarried women. On occasions both might put flowers or feathers in their hair as decorations. The Siouan women made their hair into a long roll like a "pony's" tail. This was bound with a string of beads, or a simple leather thong. The male hairdo varied more than that of the female. With all of the variation, however, a top portion was left. This could be lifted as a scalp, if the enemy was able to do so, and the brave seemed to think that it was not "cricket" unless this opportunity was afforded. In many of the tribes the males

would cut the hair from the right side of the head and leave it long on the left. Apparently this was done to keep the hair from getting in the way of action when shooting a bow. The Algonquian men usually left a roach running from front to rear along the top of the head. They might let the hair grow long on either side and bind it up in knots under the ears or at the back of the head. Frequently feathers were stuck into these.

Clothes were worn primarily for protection. The amount, therefore, depended on the season. During warm weather nothing more than a loin cloth (men) or apron (women) was needed. These were made of skins, from which the hair had been removed, or a woven fabric. Sometimes a thong was tied around the waist and leaves or grass inserted into it for modesty's sake. Prepubertial children usually went naked during the summers. When the weather got cold, garments made from skins with the hair left on constituted the principal clothing. Occasionally feathers were attached to a skin or to fabric as special garment material. Pelts of various animals were used, but in Virginia deer was more commonly used. Tattooing was commonly practiced.

Perhaps most people think of the Indian as living only in a tent, tepee, or wigwam. That may have been true of the Plains Indians, but it was not true of the Virginia Indians. The Indians lived in small villages, containing generally from 10 to 100 families. The houses were made by planting upright poles at three to four foot intervals. These were either bent over and tied together to make a roof, or else a ridge pole and other poles were put in position. The roof was made of bark, thatch, or skins. Summer houses usually did not have side walls, but winter houses had walls, made of bark, thatch, mats, skins, or logs, and sticks daubed with mud. Many houses of this kind were depicted by White and many of the post holes have been observed by recent excavators. There was a hole left in the roof for smoke to escape. Usually there was a door in front and one to the rear. Adair (1775) says: "The inside of their houses is furnished with genteel couches to sit, and lie upon, raised on four forks of timber of a proper height, to give the swarming fleas some trouble in their attack, as they are not able to reach them at one spring." Further he adds, ". . . they tie with fine white oak splinters, a sufficient quantity of middle-sized canes of proper dimensions, to three or four bars of the same sort, which they fasten above the frame." On this base they place a mattress which is made of long cane splinters. Their bedding consists of skins of bears, bisons, elks, deer, panthers, and other wild animals.

The Indians' cooking utensils were made of clay, stone, bone, wood, *etc.* The cook pots were made of soapstone in some regions, but clay vessels were in use over the entire State. These ranged in size from small cups to more than a bushel. Clay for making the pottery was collected by the women. It was carefully selected with reference to texture and freed

of all extraneous matter while in the dry condition. When mixed for use, ground shell, old pottery, slate, or sand was added as a binder. They had no potters wheel but nevertheless some of their products were extremely well executed. Pots were made by smearing clay inside a woven form (basket), outside of a form, or more commonly by rolling out cylindrical forms of clay and building up a vessel by putting down layer after layer of this "mud rope" and smoothing the layers together with the hands and a smooth rock or shell. Balls of clay that had been stored for future use have been found by the author, as have fragments of "mud rope" that had been pinched off for use in pottery making.

I have found no painted designs on Virginia pottery. The decorative motifs have been produced by the woven basket, by a stylus, by a stamp, by ears of corn or corn cobs, and by hand crimping. Crude pots, made by children in imitation of their mother's, and beautifully made play dishes have been found.

Most of the Indians in Virginia had become more or less adapted to an agricultural life; they still depended on hunting and fishing for flesh food, but most of them had their crops of corn beans, squash, and frequently tobacco. Women usually planted and cultivated the crops, although men might help with the harvest. They were familiar with some of the wild vegetable crops, but did not depend on them. In some places corn was extensively cultivated and they were able to let the Jamestown colonists have hundreds of bushels of that commodity. They especially liked tender young corn roasted in the husk (roasting ears); also they made a meal and bread of it, hominy, and a parched cracked corn that was especially good for carrying on long trips, for it kept without moulding. There was no set time for meals. Whenever one was hungry and food was available, it was time to eat. When visitors called, they were offered food by the polite Indian, and after eating the business could be attended to. Usually the men ate first and the women and children had what was left.

Fishing and hunting were done by the men. Hunting was accomplished by snaring, stalking, ambush, and surrounding. The latter method required a large number and sometimes fire was used for herding wild life into a narrow passage where the animals could be slaughtered. The hunter stalking his prey might use a skin of the animal as a disguise. Spears and arrows were the principal weapons. These were tipped with stone, bone, shark's teeth, turkey spurs, and bills of various birds.

Fish were speared with arrows, caught with bone hooks, or trapped with seines or complicated weirs. Fish hooks and sinkers have been found far inland from the sea. This indicates that the Indians engaged in fresh-water, as well as salt-water fishing. Perhaps the women were

permitted to collect shell fish. Wherever inland kitchen middens are found the numerous snail and mussel shells present bear evidence of the natives' love for these molluscs. In a midden on Glouchester point examined a few years ago, I was impressed by the fact that most of the shells found were clams, not more than four percent were oyster shells. It was quite obvious from an examination of this midden that the stench from this garbage heap would ultimately become more than the Indians could enjoy, for fires were built on the shells from time to time.

From Lederer's report, cited earlier, we are informed that the ancient inhabitants of Virginia fed only on raw flesh and fish. This was not true of the seventeenth century Indians of Virginia. Wherever remains are found, the charred bones are mute evidence of cooked meat. Reports handed down from whites who made contact with these people indicate that the Indians cooked their food more thoroughly than did the whites. They ate all kinds of animals, both invertebrate and vertebrate, and some of the men considered it effeminate to balk at anything. When going on a long expedition through unfriendly territory, where discovery would be dangerous and fires were forbidden, they generally carried parched corn, dried meat and often a pudding-like mixture called pemmican.

The Indians about whom we are concerned in this discussion thought that the gods had human shapes and therefore they represented them by images. They had priests who were older, sober men, and also conjurers, who were younger, more active men who were given to exhausting exhibitions of trickery. Henry Spelman, who spent a long time as a captive among the Algonquians, says (1884) that for the most part they worship the devil, which the conjurers can make appear at will. Each tribe has an image of its own god which is usually kept in a special house. In some cases they give presents of beads and copper to this god and at times offer special supplications. Once a year the Patomecks offer a child as a sacrifice to their god whom they call Quioquascacke.

Although the Indians were fundamentally communistic, they recognized a difference between their lords (weroances) and the common people. To quote from Strachey (1849): "Concerning the immortality of the sowle they suppose that the common people shall not live after death; but they thinck that their weroances and priests, indeed whom they esteeme half quioughcosughes, when their bodyes are laied in the earth, that that which is within shall go beyond the mountaynes and travell as farr as where the sun setts into most pleasant fields, growndes, and pastures, where yt shall do no labour; but stuck finely with feathers, and painted with oyle and pocones, rest in all quiet and peace, and eat delicious fruicts, and have store of copper, beades, and hatchetts; sing, daunce, and have all variety of delights and merryments till that waxe old there, as the body did on earth, and then it shall dissolve and die, and

come into a woman's womb againe and so be a new borne unto the world."

The Siouans believed in a supreme god and several minor deities. When people die, all travel along the same road for a long time until they come to a fork. Here the good are separated from the bad by a flash of lightning and are hurried away to a charming warm country where spring is ever lasting and every month is May. People are always young, and women are as bright as stars and never scold. The people who have been bad are taken to a dark and barren country where it is always winter. The people stay hungry and the only thing they have to eat is a bitter potato that gives them the gripes and fills their bodies with loathsome ulcers. The women are old and ugly and have panther-like claws which they use on the men who slight their passions. Attention should be called to the fact that this information was recorded by William Byrd about 1728, and it looks very much as if the Indians had been influenced by white man's religion.

The Iroquoians concept of religion was not obtained until occasional contacts with the whites for over a century. The account that we have shows a decided similarity to the Christian belief and must be considered as influenced by it.

Among the Algonquians, and other Indians in Virginia, it was the custom for a man to have as many wives as he wanted and was able to buy. For the wealthy polygyny was the rule, and it is said that Powhatan had over 100 wives. When a chief wanted additional wives, the fairest in the land were brought to him. If an ordinary man became interested in a girl, he would inquire of her people as to the price demanded; and if the arrangements were satisfactory, the woman would go to him upon payment of the requested amount. In some cases promises were accepted in part, and if the woman was passed on to some other man before this was paid, the second husband would assume that obligation. Apparently a woman could not be "given in marriage" without her consent. Prior to marriage, which took place at an early age, girls bestowed their favors on whom they wished. Among some of the tribes these "light o' loves" accepted gifts for their favors. Also there was a class of prostitutes made up of adulteresses and outcasts who advertised their trade by the way they painted their faces. Sometimes men made temporary alliances with such women.

Marriage itself was a serious affair, and adultery was severely punished. Among some tribes only the man was held guilty. He might have to take the woman as wife and pay her people any outstanding obligations, or pay the husband the amount of the marriage dowry, or for presents he had made to her, or for the loss of her services in his garden and cornfield. Sometimes death was the penalty.

The ritual associated with marriage varied from tribe to tribe. In some cases a string of beads of the demanded length was broken over the couple's joined hands; a bowl of food was placed under the eaves of the girl's people's corncrib and if the girl allowed the youth to steal up and take a spoonful of it, he was accepted; reeds exchanged between the two; an ear of corn divided between them; venison given to the girl by the boy and an ear of corn given to the boy by the girl. Before marriage the man was supposed to possess a house as pointed out by Hawkins (1848) ". . . when a man has built a house, made his crop, and gathered it in, then made his hunt and brought home the meat, and put all this in possession of his wife, the ceremony ends, and they are married." In some tribes the union was not considered to be established until after the succeeding harvest festival (busk). Until that time either could leave the other, but afterwards the woman was considered to be bound to her husband. Should a man marry a second wife he could not bring her into the same house with the first wife without her consent. Also he was supposed to have the first wife's consent to subsequent alliances.

Swanton (1946) says: "In succession to the chieftainship Algonquians preferred the female side to the male side though there is no evidenc of a totemic system." Powhatan inherited his office through his father and he passed his authority on to his brothers and son. In some of the tribes authority was through matrilineal descent.

The methods of disposing of their dead differed greatly among the different tribes and among the different classes within a tribe. Usually important persons were disposed of in a manner to indicate belief in an after life. Attention has been called to the fact that the chiefs and priests were considered to be in a different category from the average person by some of the tribes. When members of this higher category died their bodies received special attention. Some of the Virginia Indians disposed of the bodies of their dead chiefs very much like Hariot (1588) described for the Carolina Algonquians: "They build a scaffolde 9 or 10 foote highe . . . and lai the dead corpses of their weroans theruppon." In preparing the corpses for deposition on the scaffold the viscera are first removed, then the skin is taken off and all of the flesh is cut from the bones. The bones are dried and put back into the skin and this is stuffed with dry grass or sand and sewn up. The scaffold is under a roof and by the body an idol is placed. A priest lodges under the scaffold and mumbles prayers day and night. Such temples may be kept for years and come to contain many of their chief persons. Spelman (1884) says that the corpses of ordinary persons are placed on scaffolds 9-12 feet high and apparently are left there until all the flesh is off the bones. The bones are then placed in a mat and hung up in the house until it falls down, after which they are buried among the ruins.

The Siouans sometimes put their dead in temporary open graves until the flesh had disappeared and then placed the bones of important persons in caves, if they were available. The bones of lesser persons would be collected in bundles and buried indiscriminately in mounds. Jefferson (1801) dug into the Saponi mound near Charlottesville, Virginia, and estimated that it contained about 1,000 bodies, the bones occurring in a jumbled manner. Numerous skeletons have been removed from several places in Virginia. The author, with Mr. John H. Reeves, Jr., has removed about twenty skeletons from a recently located site on the Staunton River, Halifax County. Most of these were buried in the flexed position and lying on the left side In one case a person and a dog were buried in one corner of a house, a person in each of two other corners, while the fourth corner was used as a garbage pit.

The dog was placed on a cairn of stones, but there was no evidence of special offerings with adult skeletons. Whenever children skeletons were uncovered, ossuaries and beads were usually found. This is suggestive of the practice of the ancient Mycaenians. Skeletons unearthed by Mr. Reeves on the New River, near Eggleston, showed a similar practice. These were probably Monetons, while the skeletons found on the Staunton River might have been Saponis.

Timberlake (1765) says of the Cherokees: "They seldom bury their dead, but throw them into the river; yet if any white man will bury them he is generally rewarded with a blanket, besides what he takes from the corpse, the dead having commonly their guns, tomahawkes, powder, lead, silverware, wampum, and a little tobacco, buried with them."

When northern Europeans overran the Roman Empire, the conquering hordes became amalgamated with the vanquished and, to a great extent, took over their language and culture. When some of the descendants of these same northern Europeans conquered the primitive tribes inhabiting Virginia, there was little amalgamation and but little of this primitive culture was appropriated and adapted to the use of the colonists. For the most part the natives were exterminated, placed on reservations, or driven westward. At one time the red man seemed to be doomed to extinction, but during the past several decades he has made a comeback. There are about one half as many Indians in the United States now as there were in 1607. There are only about one thirtieth as many in Virginia as there were when Jamestown was settled and most of these are of mixed blood.

Swanton (1946) says that "No considerable number of Powhatan (Algonquian) Indians seem ever to have removed from the locality. They gradually died out or retired into one or two reservations where a few mixed-blood descendants still live." These include "the Pamunkey, Chick-

ahominy, Powhatan, Mattapony, Werowocomoco, Nansemond, Rappahannock, Potomac, Tappahannock, Wicocomoco, and Accohamoc, though only the first two are of any considerable size. Hodge (1912) calls attention to the fact that with the treaty of Albany in 1722, the history of the Powhatan tribes practically ceased and the remnants dwindled to near extinction. "They now number altogether about 700, including the Chickahominy, Nansemond, Pamunkey, and Mattapony."

All of the Siouan Tribes have departed from Virginia. The Monacans remained on the James River at Manikin until after 1702. They probably joined the Indians from Fort Christanna when they migrated to New York about 1740 and established themselves among the Iroquois. The Manahoacs were at Fort Christanna in 1714. They united with the Saponis and went with them to New York, after which they disappear from history. It is not known whether the Monetons joined the Tutelos or moved westward. The Saponis, Nahyssans, and Occaneechis were at Fort Christanna and went to New York. They were adopted into the League of Iropuois in 1753.

The Iroquoians seem to have been more adept at playing the "balance of power" game. Perhaps because of this they have left more descendants. The Meherrins probably united with the Tuscaroras and moved to New York, where they joined the Confederation about 1722. The Nottoways, called Mangoacs by the Raleigh expedition, maintained their identity until as late as 1825, when they were living on a reservation in Southampton County. In spite of broken treaties and repeated encroachments by the whites, the Cherokees maintained their position until 1836, when the bulk of them were forcibly moved beyond the Mississippi. About 1,500 remained behind and were subsequently placed on a reservation in western North Carolina. These have multiplied, as have those in Oklahoma, so that now there are twice as many of them as there were in 1607.

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Geologic Ancestry of the York-James Peninsula

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FOREWORD

The Peninsula was discovered and settled by the first Virginia colonists 350 years ago through the historic landing on Jamestown Island. That fortuitous event was the precursor of all the history of Virginia during the last three and a half centuries. Far back in time as 1607 seems to us in this eventful age, the elapsed centuries are not a second as measured against the geologic time recorded in the rocks, rivers, and landscapes of the Peninsula.

How old, then, is the Peninsula? How was it developed? What has been its geologic ancestry? What particular geologic events prepared the way for the landing at Jamestown?

READING GEOLOGIC RECORDS

To read meaning into the geologic manuscripts of the Peninsula, which contain the records of its earth history, and to interpret them validly, one should comprehend the elements of geologic field research. A geologist is no less a skilled detective than a versatile Sherlock Holmes. He studies clues in rocks and minerals, hills and valleys, and seacoasts and rivers instead of human personalities and aberrations. The geologist is always seeking clues to past natural events so as to reconstruct the history of the earth and its inhabitants. To do that logically, he should be proficient in the field observation of present geologic processes, for "the present is the key to the past." An active, logical imagination is almost indispensable, for the observing interpreter must envision agents, processes, and results on a grand scale throughout eons of time. Many geologic records present perplexing problems because of their antiquity, stupendousness of ultimate events, and partly because many of the processes and results cannot yet be duplicated in laboratories. This state of affairs is a challenge and a lure to geologic research. The records and problems of the geologic history of the Peninsula are, however, relatively simple.

The geologic ancestry of the Peninsula is derived from observable features: landscapes along the shores and inland; Chesapeake Bay and its tributary rivers; surface and subsurfaces rocks; and the fossils of former

[1] State Geologist of Virginia. 1929-1947.

indigenous organisms—plants, invertebrates, and vertebrates. All of these data must be critically studied, having constantly in mind the guiding axiom—the present is the key to the past.

As rivers now carry gravel, sand, silt, and mud toward the sea, so did they throughout geologic ages from the time rain fell on the young solid earth. As those sediments now accumulate in layers along river flood plains, in lakes, and in shoal waters along seacoasts, so did they during all past centuries and geologic periods. Calcareous sediments are now being produced chemically and biochemically in lacustrine and marine waters; they were no doubt formed under similar environmental conditions throughout geologic time.

Fragments of land plants become buried in sands and muds along river channels and flood plains and in estuaries. Shells and other hard parts of invertebrate animals are incorporated in some sediments, especially muds and calcareous oozes. Fresh-water clams and snails leave their shells in alluvial and lacustrine deposits. Marine invertebrate remains are characteristic of many sands and muds deposited in the sea. They are common in calcareous sediments, derived in part from their shells and other hard parts. Skeletal parts of land vertebrates are found in river, swamp, and lake deposits; of marine forms, *e.g.*, sharks, in marine sediments.

Each landscape feature, whether a river valley, a hill, or remnant of an upland plain records specific geologic history. Each has been fashioned by some geologic agent through long intervals of geologic time. The most common and ubiquitous sculpturing agent in humid climates is running water, as rills on slopes and streams in valleys. Waves and current along a seacoast erode the shore and transport sediments to depositional areas. Long-continued wave erosion at a stable sealevel reduces the adjacent land to a submarine plain, bordered landward by a cliff or escarpment. Winds transport sands from beaches and flats to construct dunes. Water percolating underground dissolves soluble mineral matter, chiefly calcareous, and carries it to other sites.[2]

The essential point to keep in mind in understanding geologic records in the Peninsula, or elsewhere, is that as geologic agents now erode and sculpture the land, transport and deposit sediments to build sedimentary rocks and certain land forms, so have they done since the earliest recorded geologic time. This principle of uniformitarianism, in general, is another guiding axiom in deciphering earth history.

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[2] Details and examples of these common geologic processes cannot be given here; a textbook on geology should be consultud. Only those relevant to the interpretation of the geologic ancestry of the Peninsula are mentioned.

FIELD OBSERVATIONS

Surface features. — The Peninsula is a part of the Coastal Plain of Virginia, popularly known as Tidewater Virginia. In a board view, as from an airplane at high altitude, the region appears to be a plain with a gentle eastward slope. The inner margin is at the somewhat irregular eastern edge of the Piedmont province, along the Fall Zone where rivers, such as the James, descend over rapids and low waterfalls. Early Richmond, for instance, was located at the Fall Zone — the head of tidewater navigation. The outer border of the Coastal Plain is deeply indented by bays and estuaries, of which Chesapeake Bay is the most prominent and, for this account, the most significant. The eastern part of the Coastal Plain is now submerged; the surface slopes gently under the ocean.

The lower part of the Peninsula lies between two broad and beautiful tidal rivers, the James on the southwest and the York on the northeast. Northwest of the confluence of the Pamunkey and Mataponi rivers to form the York, the valley of the former may be taken as the northern boundary of the Peninsula. The Peninsula thus has within its borders one large, long river, the Chickahominy. It has a remarkably tortuous course, as has the James to a less extent in its upper Tidewater reaches. The Pamunkey is similar, flowing seaward in broad sweeping curves.

Because the lower part of the Peninsula is bounded on three sides by deep valleys, including Chesapeake Bay, its borders are digitate. Along the Bay the land is deeply indented by estuaries of Back and Poquoson rivers and their short tributaries. The bay borderland consists of "necks," smaller bays, marshes, islands, and shoals. A long coastal bar or beach extends northward from Old Point Comfort into the Back Bay estuary.

Valleys tributary to the James are partly submerged, or "drowned." Low riverside islands, such as Jamestown, have been separated from the mainland of the Peninsula by the relatively high waters in the James. Marginal swamps are rather common. A few necks of land. *e. g.*, Curles Neck, are almost enclosed by the broad meandering curves of the river. Similar drowned tributaries, swamps, and islands are marginal features of the Pamunkey and Chickahominy rivers. The York River is almost straight. Its short tributaries are also drowned. Steep cliffs border the York in the vicinity of Yorktown.

The surface of the Peninsula rises gradually northeastward from slightly below sealevel to an altitude of about 200 feet on the flattish upland near Richmond. The outer part is submerged. The Peninsula is a low, broad plain in most of York, Warwick, and Elizabeth City counties. Here it is only slightly dissected by streams except for the bayside indentations. The surface rises imperceptibly to a maximum gen-

eral altitude of about 50 feet southeast of Lee Hall and Yorktown. Extensive stream dissection has destroyed most of the original plain northwest of these points. Intervalley uplands are remnants of the gently sloping plain. The uniform continuity of the seaward slope is interrupted by low escarpments—the landward "risers" of broad, approximately north-south trending terraces.

Observable rocks. — The outcropping rocks are much more ancient manuscripts of its geologic history than are the surface features of the Peninsula. They are exposed in cuts along streams, roads and railroads, and in excavations of all kinds.

The visible rocks of the Peninsula are sedimentary, *i. e.*, their constituent particles were laid down as sediment — pebbles, sand, silt, mud, and shell fragments. Most of the sediments are still unconsolidated or loosely consolidated. Rainwater and snow-water percolating downward from the surface have dissolved soluble material and redeposited some of it as cement to bind together some of the sediments: pebbles into conglomerate, sand grains into sandstone, and shells and shell fragments into marl. Mud flakes and clayey particles formed layers of clay. The particles of these sedimentary rocks have been more or less sorted according to size and shape into layers or beds.

Some of the strata contain plant remains, particularly those near the Fall Zone and in surficial deposits. Fossil shells occur here and there; however, they are abundant in bluffs along the York above and below Yorktown and in a few outcrops along the James. Most of the forms are pelecypods and gastropods. More than 100 species have been collected by the School of Geology at the University of Virginia. Vertebrate fossils consist of vertebrae and other parts of whales and teeth and vertebrae of sharks.

Geologic formations. — Geologists classify sedimentary rocks into formations, each having distinctive physical characteristics and, perhaps, a diagnostic fossil flora or fauna. Each formation was deposited during a particular stage of geologic time. Such an orderly classification is essential to depict the distribution of contemporaneous strata upon a geologic map as well as to arrange the episodes of geologic history in a proper and understandable sequence. As in a stack of books, the topmost formation is the last one that was laid down; each lower stratum was placed earlier and thus is increasingly older. This natural order of superposition is of critical importance in arranging the manifold events of earth history in a true succession. When the natural vertical succession of strata has been determined, fossils in the beds can be used to identify more or less contemporaneous formations, even at widely separated localities.

The geologic succession of plants, invertebrates, and vertebrates has in general been worked out for much of the entire sequence of sedimentary rocks, from the oldest fossil-bearing beds to the youngest. Hence the twin principles of superposition and of the geologic evolution of organisms enable stratigraphers and paleontologists to correlate, or match approximately in time, formations that cannot be traced at the surface because of the scarcity of outcrops. The same method is used to identify strata penetrated in deep well borings, often many miles apart. In this manner formations that are meagerly exposed on the Peninsula can be shown on a geologic map according to their geologic ages and extent.

Thickness. — The sedimentary rocks on the Peninsula range in thickness from a feather edge near the Fall Zone to a measured maximum of about 2,250 feet in the deep well at Fort Monroe. They have been traced seaward in a geophysical traverse: their thickness is calculated to be more than 12,000 feet below the submerged plain about 60 miles east of Cape Henry.

Structure. — The attitude, or structure, of the formations on the Peninsula is not immediately obvious, for the stratification is commonly poor or indistinct. The structure, however, is simple. Recognizable beds in restricted exposures appear to be horizontal; notwithstanding, it has been found that over extensive areas the upper strata dip seaward at about 10 feet per mile. Data from well borings indicate that the deeper beds have somewhat steeper seaward dip; also, that in places they may be broken and displaced by faults.

Foundation rocks. — The sedimentary formations of the Peninsula rest upon a foundation of much older rocks which are of two main types. Very old crystalline rocks — "basement rocks" — crop out along the Fall Zone and underlie much of the Piedmont region. They consist of igneous rocks, and highly altered sedimentary and igneous rocks. The other type is exposed in the Richmond coal basin, comprising sedimentary "red beds," other strata, and coal. Some igneous rock was intruded, in a molten state, into these formations. These rocks are very much younger than the ancient crystalline rocks of the Piedmont but are much older than the sediments that comprise the upper crust of the Peninsula.

It is a logical and safe inference that both groups of rocks underlie the Peninsula, at increasing depths seaward. The red beds were penetrated by a well in another part of the Coastal Plain. A well drilled in 1902 at Fort Monroe struck crystalline rock at a depth of 2,240 feet. A boring made in 1929 at Mathews Court House reached granite at 2,300 feet below sea level. A later geophysical traverse determined the depth to basement rock at Cape Henry to be about 2,900 feet.

These foundation rocks afford considerable information about the early stages in the geologic development of the Peninsula. Its early history can be soundly inferred only from an intensive study of the rocks in the Piedmont province of Virginia. Even the great pile of sedimentary formations in the Valley of Virginia, which probably lies upon similar foundation rocks, affords numerous clues to ancestral conditions and events in the area of the Peninsula before its mantle of sedimentary rocks was deposited.

GEOLOGIC TIME

Just as the significant events of human history have been chronicled in terms of ancient, medieval, and modern history, so the known important events of earth history have been arranged in time categories. Virginia's physical ancestry, in which the peninsular area inevitably participated, progressed through four great eras of geologic time. Each of those eras was characterized by some distinctive combination of events and the approximate end of each one was marked by some particularly significant series of events.

Eras have been divided into major units of time, called periods, each with more or less characteristic records. This classification of geologic time is rather similar in general nature to the division of human history into periods and epochs. It is a natural division of geologic history; it is also essential for a clear and world-wide interpretation and comprehension of the succession of geologic events. The classification is based in part upon major physical changes on the continents and in part upon changes in contemporary floras and faunas, whose remains have been entombed in the strata.

The names of eras and periods may seem odd to a layman, but they mean more than mere convenience in classification. Each name of an era is based upon the stage of evolution of the whole organic realm including the dominant types then living. Most period names have been derived from a geographic unit in which formations of that age were first described. A few names designate sedimentary deposits that were peculiarly characteristic of that time.

The geologic ancestry of the Peninsula can be most clearly and concisely presented by reference to the geologic time scale. It is given below in abbreviated form, with the major events on the Peninsula indicated.

GEOLOGIC CHRONOLOGY OF THE PENINSULA

Era	Life stage	Period	Typical animals	Peninsula record
Cenozoic	Recent	Quaternary	Mammals	Present landscapes Surficial sediments
		Tertiary		Principal sediments
Mesozoic	Medieval	Cretaceous	Reptiles	Oldest sediments (?)
		Jurassic		Probably erosion
		Triassic		Local sediments (?)
Paleozoic	Ancient	Permian	Invertebrates	Probably erosion throughout era, of landmass supplying sediments westward
		Carboniferous		
		Devonian		
		Silurian		
		Ordovician		
		Cambrian		
Precambrian				Basement rocks akin to Piedmont rocks

GEOLOGIC ANCESTRY

It is evident that the Peninsula was affected by most of the major geologic events whereby was constructed the physical framework of Virginia and adjacents parts of the continent. The oldest accessible records of its geologic ancestry are those in the basement crystalline rocks that crop out extensively in the Piedmont region and form the foundation of the Peninsula. Those rocks record events of Precambrian time and also some during the following Paleozoic era.

Precambrian history. — The principal events to be deduced from the great body of most ancient rocks are these: widespread deposition of thick

masses of clastic sediment; intrusion of large masses of molten rock into pre-existing rocks; the rise of other bodies of molten rock to the surface where they became lava flows; very widespread and intense deformation of most of the Precambrian rocks; and alteration of the sedimentary formations and some of the igneous rock into completely crystalline metamorphic rocks.

Because of their thorough alteration, the original sediments are now scarcely recognizable. Nevertheless, the ancestry of the present rocks can be interpreted from some of their characteristics, such as constituent minerals, internal structure, and chemical composition. The source and depositional environments of the ancient sediments are unknown: the events were too remote and the obscuring later changes too great for confident interpretations. It is surmised that those sediments were derived from a landmass that may have included the site of the Peninsula; or it may have been situated east of the present seacoast. In the latter geographic relationship, the Peninsula may have been partly occupied by one or more of the troughs that received the land waste.

Throughout the decipherable history of the earth, rocks have melted in the deep interior and have risen toward the surface as large molten masses. Many of these magmas came to rest at considerable depths where they cooled slowly and crystallized to form intrusions of granite and other igneous rocks. Some of those within the basement rocks of the Piedmont and the Coastal Plain were injected during Precambrian time. It was formerly thought that most of them were of that age. Research in recent years upon the characteristics and environmental relations of the Piedmont intrusive masses indicates that some of them were associated with the profound crustal movements that occurred in eastern North America during the closing epochs of the Paleozoic era.

Some of the magmas were sufficiently fluid and were subjected to strong propulsive forces that brought them onto Precambrian land surfaces. There they spread over the land like lava flows do today. They have been found at several places in the Piedmont and the Blue Ridge. None has yet been encountered in deep borings in the Tidewater section.

The severe deformation and intense metamorphism of most of the Precambrian rocks denote that they were subjected to great compressive stresses. It may be that mountain ranges were produced, perhaps also far out in the Atlantic basin of today. Upwarping and folding of the late Precambrian land no doubt accelerated the processes of rock disintegration and stimulated the streams to transport rock waste to various basins. Reduction of the uplands and deposition on the lowlands may have produced a broad undulatory plain with local hills and ridges.

Paleozoic history. — The geologic history of the Peninsula and the Coastal Plain in Virginia during the few hundred million years of the Paleozoic era must be inferred. Indubitable clues to some of the conditions and events are found, however, in the great mass of Cambrian to Carboniferous sedimentary rocks that underlies the Valley of Virginia and composes the mountain ridges and valleys to the west.

The topography of the Virginia area during the Paleozoic era was extremely unlike the present surface. A prominent landmass at the east was bordered by a broad sea to the west. A succession of invasive seas flooded the sites of the Blue Ridge, the Valley, and the mountains far west of Virginia, from Cambrian time at least through the early part of the Carboniferous. Some of those seas joined the north Atlantic with the Gulf of Mexico or its Paleozoic counterpart. The eastern shores of those seas is unknown; some of the eastern Piedmont was covered during the Ordovician period by marine waters.

An extensive landmass lay between the interior seas and the open Atlantic. Geologists long ago named it "Appalachia." Its actual extent and character can never be known, for it disappeared before late Mesozoic time. How is it known, then, that it ever existed? That interpretation is attested by the Paleozoic sedimentary rocks in and west of the Blue Ridge. The enormous volume of sand and mud that now makes up the sandstones and shales of that region was swept into the interior seas by streams that flowed down the western slopes of Appalachia. Much of the clastic sediment could have had no other source. That Paleozoic land mass may have been at times a bold mountain range. It may have occupied part of the Tidewater area or it may have been situated entirely east of the present coast.

Late Paleozoic cataclysm. — Before the end of the Paleozoic era, cataclysmic disturbances disrupted the eastern border of the continent. Irrestible forces impelled from the southeast buckled the Paleozoic strata into a broad series of huge corrugations. They trended northeast and southwest. The lateral pressure toward the interior of the continent ultimately became so intense that many of the overturned folds were broken and thick slices of the earth's crust were gradually propelled for many miles to the northwest. These long-continued convulsions in the outer shell of the earth produced the ancestral Appalachian mountains—a high mountain chain that may have had the grandeur of the present Rocky Mountains.

That late Paleozoic-early Mesozoic mountain system also eventually disappeared. Proof of its existence, nevertheless, is direct and obvious because the great folds in the strata are cogently evident in every crossing of the present Appalachian Mountains.

The effect of the birth of the old Appalachian mountains upon the coastal part of Virginia is unknown. Any inference is mere conjecture. The old landmass of Appalachia may have been slowly engulfed by the Atlantic. Perhaps it had another fate.

Mesozoic history. — As soon as the ancestral Appalachian mountains began to rise above the common level of the land, the forces of rock decay and disintegration attacked them, especially running water. Streams on all slopes transported rock debris to lower levels, always toward the sea. During the 130 million years of the Mesozoic era the uplands were gradually worn down to a vast plain. It covered all of Virginia and the eastern part of the continent. It sloped toward the Atlantic across the Peninsula, where it is buried under a mantle of younger sediments. Hills and ridges on more resistant rock or farther removed from main drainage courses stood in places above the plain. The geologic age of its completion is uncertain; perhaps in the Cretaceous period.

During the Triassic period large, elongate basins were developed in the Piedmont region. Thick bodies of sand and mud were deposited in them. Parts of the basins were at times occupied by swamps in and beside which lush vegetation grew. Vegetal debris which accumulated in the swamp waters eventually became coal beds. Molten rock at intervals invaded the strata. Some of these basins may have been formed in the Coastal Plain, possibly in the northwestern part of the Peninsula.

The Jurassic period was a time of widespread erosion in the eastern part of the continent. No sediments of that age are known in Virginia. The vast erosional plain mentioned above may have been in its penultimate stages. If Appalachia were destroyed by long-continued erosion during the Mesozoic era, the final phases were completed during this time of general planation of the land.

During the Cretaceous period the geologic record in the Peninsula became more definite and clearer, for sediments of that age have been preserved. It is from the rocks formed during a geologic period that the contemporary geography and geologic activities can be deduced with a fair degree of certitude.

Early Cretaceous sediments are chiefly gravels, sands, and clays, locally with considerable lignitic material, which lie upon the basement crystalline rocks. Most of the sediments are unconsolidated although some of the gravel has been cemented into conglomerate and some of the sand into sandstone. Abundant plant remains include ferns, cycads, and conifers. True flowering plants had not yet become numerous or abundant.

These data show that late in the Jurassic or early in the Cretaceous period, perhaps during both, the vast erosional plain was tilted — up toward the west and down toward the sea. This gradual uplift rejuvenated the streams that flowed toward the Atlantic so that they began to scour off the thick mantle of decayed rock upon the plain. The lignitized wood — incipient coal — and fossil land plants, together with the absence of marine fossils, suggest that the rivers emptied into marshes and estuaries on a broad coastward flat. Topographic conditions were perhaps similar to those along the eastern side of the present Coastal Plain.

The sea may have submerged the eastern part of the Early Cretaceous coastal plain, which inclined seaward, but because marine fossils have not been found in deep well borings its shore is unknown. A pronounced thickening of the strata from the Fall Zone to the deep well at Fort Monroe indicates that the land was tilting seaward during Early Cretaceous time.

The sea encroached upon the eastern Coastal Plain during Late Cretaceous time, for sediments with marine fossils of that age were penetrated in deep wells near Norfolk and at Old Point Comfort. How far the sea spread inland or whether it submerged much of the Peninsula will be unknown until more deep wells have been drilled in that area. A low coastal plain sloping gently seaward would have favored marine invasion.

Tertiary history. — The Tertiary is the earlier period in the era in which we live. It began approximately 60 million years ago. Sediments were deposited over much of the Coastal Plain during that period; hence the Tertiary history of the Peninsula is more completely evident than at any previous time.

During the early part of the period (Eocene) the sea slowly crept over the Peninsula at least as far west as the Fall Zone. This may have been one of the most extensive submergences of the Tidewater Virginia region which throughout most of prior geologic time had been land. Streams had eroded this land into an irregular surface before the sea submerged it, as is shown by the uneven lower surface of the Eocene deposits. Some of the sediments appear to have been deposited in basins where they are much thicker than elsewhere.

Most of the time during the Eocene epoch rivers carried fine sand and clay to the incoming sea. Much greensand (glauconite) was formed in offshore waters. Marine invertebrates abounded: the strata contain many shells of many species of pelecypods and gastropods. Some of the beds are shell marl. Well cuttings from deep borings in 1941-42 at

the Navy Mine Depot at Yorktown contained many tests of numerous species of Foraminifera.

The second epoch (Oligocene) of the Tertiary period seems to have been a time of relatively static conditions on the Peninsula. The Eocene sea had withdrawn into the Atlantic basin, possibly because of a slight upward tilt of the land. Erosion was slight upon the Peninsula and deposition was virtually nil; at least there is no clear record of either process having been active. The area probably was a stable, low, flat coastal plain. Toward the Fall Zone, however, an eroded surface lies beneath the oldest Miocene sediments. That area was land, crossed by eroding streams.

During the next epoch (Miocene) the sea advanced again toward the Fall Zone, in places flooding beyond it. This was the last extensive marine submergence of the region. In the early part of the Miocene, rivers carried much fine sand to the sea, where it was reworked and distributed by the waves and littoral currents. Some greensand was produced off shore. That sea harbored an abundant and varied fauna, as is shown by the many species of fossil gastropod and pelecypod shells as well as numerous other forms of invertebrates. It contained some vertebrates, *viz.*, fish, reptiles, and mammals, some of the remains of which have been fossilized. Peculiar marine conditions for a long stage permitted billions of diatoms to flourish: microscopic plants that extracted silica from the sea water to form their remarkable and, in some species, beautifully ornate tests. Leaves from land plants floated down the rivers to become imbedded in the estuarine and littoral sediments.

After the initial Miocene formation was deposited, the sea appears to have withdrawn, for sediments deposited farther north are lacking on the Peninsula. The area was submerged again during the Middle Miocene. Rivers contributed large quantities of clay and less quartz sand to this sea than to the Early Miocene sea. These sediments indicate that the Piedmont source areas were mantled deeply with the products of long-continued rock decay. The turbid waters prevented the growth of the large colonies of diatoms which had been so characteristic of the Early Miocene sea. Considerable shell marl and the abundance of fossils denote the richness of the marine invertebrate fauna.

It is uncertain whether this sea withdrew from the Peninsula and advanced again over the area in the Late Miocene or whther the supply of terrigenous sediment was depleted. In either case the marine waters were at times clearer; hence the uppermost Tertiary formation in many places consists chiefly of shell marl or coquina. Excellent exposures are in the cliffs up and down the south side of York River near Yorktown.

This section of Miocene strata was named the Yorktown formation from these typical sediments. These outcrops and beaches have long been

noted places for collecting fossils — among the best Tertiary ones on the Atlantic Coastal Plain. Professor Joseph K. Roberts of the School of Geology at the University of Virginia reported two decades ago that he had collected "110 of the reported 123 species". That fossils are predominantly shells of gastropods and pelecypods, but most of the invertebrate phyla are represented. Some outcrops yield shark teeth and the vertebrae of whales.

Toward the close of the Miocene epoch the sea withdrew from the Peninsula and the rest of the Coastal Plain in Virginia, never to flood the region extensively again. A long period of emergent land ensued during which streams from the Piedmont and western parts of Virginia brought gravel and sand and deposited them on flood plains in the Peninsula. These Late Tertiary or Early Pleistocene sediments have been preserved at several places, *e.g.*, east of Williamsburg. Some of the pebbles of limestone were derived from outcrops west of the Blue Ridge, as is proved by the Paleozoic fossils in them.

Pleistocene history. — The Quaternary period is divisible, chiefly for convenience of reference, into an earlier or Pleistocene epoch and the present or Recent epoch.

The Pleistocene epoch is also called the "Great Ice Age," because expansive sheets of ice — continental glaciers — spread over much of Canada and the northern United States. South of the southern limit of glaciation other geologic processes were normally active, except as they were affected by changes in climate and precipitation. One effect was pronounced on the Peninsula and other parts of the Coastal Plain — the fall and rise of sea level causing lands to emerge far east of the present shore and then to be flooded a considerable distance west of the present coast. This slow cyclic fluctuation of sea level was in response to the locking up of large amounts of evaporated sea water in the huge ice sheets, followed by its slow return to the ocean as those glaciers melted during the warmer interglacial stages.

Four distinct Pleistocene glacial stages have been recognized from geologic records in the glaciated region; likewise, four interglacial stages if the present stage is counted as one of them. (It may, however, be a post-glacial stage, in which case the term "Recent epoch" may be somewhat appropriate.) Responses of sea level to the variable supply of water are recorded on the Coastal Plain though in general not so well on the Peninsula. The invading seas smoothed their new floors, partly by wave and current erosion and partly by sediments eroded from the coasts and contributed by tributary rivers. This mantle of recent sediment constitutes some of the surficial formations on the Peninsula. Large rivers dropped parts of their loads of gravel, sand, and silt along their lower courses before they reached the seas. As successive seas withdrew from the pre-

sent land surface, James and York rivers of necessity extended their courses across the newly emergent sea floors, as they had done in each prior cycle of emergence since the Cretaceous sea invaded the Coastal Plain.

An index to the climate in Virginia during the glacial stages is afforded by striated cobbles and boulders in some of the fluvial and estuarine sediments. In this part of the state these erratics occur mainly south of the James. They have the earmarks of ice transport and scoring. Because they occur far south of the terminii of the continental glaciers it seems most probable that they were ice-borne in rivers from the colder regions of the upper Piedmont and the Blue Ridge; perhaps even from the upper valley of the James in the distant mountains.

The shore of each invading Pleistocene sea is marked by a moderately steep upward slope or subdued sea-cliff. The present surface of the region consequently is composed of a series of broad plains, or "treads," and north-south trending scarps, or "risers." These are the coastal plain terraces. The most recently exposed submarine plain, or sea floor, is the broad, low surface in the southeastern counties of the Peninsula. That gently sloping plain in late Pleistocene time was exposed land far east of the present coast. The mouths of the York and James were east of their present positions. These interpretations are clearly evident from the deep channels that lead into the ocean. The lower part of the James – the magnificent harbor of Hampton Roads – is approximately 100 feet deep. The lower York is about 80 feet deep. These stream-scoured valleys could have been cut mainly in a land surface only, at considerable height above the sea, even though sediment-laden submarine currents may have partially scoured them. The extreme eastern edge of the coastal plain during its maximum emergence is unknown.

At this relatively recent geologic stage in the ancestry of the Peninsula its seaward portion was a low swampy plain. Its inland portion was higher above the sea than now. This altitude provided stream gradients and velocities that caused the James and the York to deepen their channels. The erosive power of their tributaries was accentuated; hence they dissected the western upland into the present pattern of ridges and valleys. Chesapeake Bay in its present form did not exist. Its area was occupied by the drainage system of the lower part of the great Susquehanna River. The York and the James were major tributaries.

Recent geologic events. – An immense volume of evaporated sea water was temporarily locked in the million or more cubic miles of ice that constituted the last great continental glaciers. As the cold Pleistocene climate moderated, large quantities of melt waters from the wasting ice sheets flooded rivers which poured the water back into the Atlantic and

other oceanic basins. Those basins, therefore, became filled to overflow and the sea again gradually inundated the coastal plain. The seaward portions of the James, York, and similar rivers became estuaries and tidal channels; in the James today even to Richmond. A major part of the large, ancestral Susquehanna Valley and its major tributaries were slowly drowned to make Chesapeake Bay. As the sea crept farther inland, sluggish tributaries of the James and the York also were drowned, and the adjacent lowlands became swamps. With their gradients and velocities decreased, the rivers wandered from side to side across their low floodplains in broad meandering curves. Shallow depressions across some of the riverside peninsulas became short straits and the "necks" of land became islands. Jamestown Island is typical.

The long coastal bar or barrier beach that extends northward from Old Point Comfort into the Back Bay estuary has been built recently by waves and wind-driven shore currents which swept sand northward along the shallow sea floor. Winds have heaped up dry sand locally into dunes, as at Cape Henry. Flooded rivers have carried silt and clay into the estuaries, gradually converting them into mud flats on which vegetation slowly gains an anchorage.

Through its long and diversified geologic ancestry the Peninsula was gradually developed to its present form and constitution. It was the setting of the stage, so to speak, for the chance landing of the first colonists on Jamestown Island. Their activities and those of successors were henceforth influenced in part by environmental conditions inherited from that geologic ancestry.

Age of the Peninsula. — The foundations of the Peninsula were constructed a half billion and more years ago. This deduction is based upon the age determination of certain minerals in analagous crystalline rocks in the upper Piedmont and elsewhere, by study of the isotopes of elements involved in radioactive disintegrations. A characteristic mineral in Amherst County, for example, has been determined to be of the order of 800 million years old. The superstructure of sedimentary formations which was built up from Early Cretaceous time to the latest Pleistocene encompasses approximately 110 million years. The last Pleistocene sea retreated into the Atlantic basin a few tens of thousands of years ago. The present inundation of the Coastal Plain and the lower Peninsula has been in progress, perhaps, for 10,000 years, though possibly for even less time.

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Seventeenth Century Science in Old Virginia

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When the first permanent English settlers came to Jamestown in 1607 they found a new raw land so different from what they were accustomed to in old England that they had the greatest difficulty in adjusting to the new life. The immediate problem was survival. Science could only be of an exploratory type, directed toward the discovery of commodities "for victuall and sustenance of mans life." Native animals and plants, the soil, rocks and minerals, the possible occurrence of gold, the geography of the area, the climate, the character and ways of the Indians – all must have been of intense interest and of great importance to the settlers.

Rosy prospects of immediate wealth were held out to the gentlemen adventurers and others from England. The experience of Spanish conquistadors and explorers in Central and South America must have inflamed the imagination and excited the cupidity of Europeans in the early seventeenth century, especially because of the writings of Oviedo.

Our settlers might have learned something about Virginia from the first report to go back to England. This was "*A briefe and true report on the new found land of Virginia*" by Thomas Hariot, the mathematician. Hariot went as historian, surveyor, and explorer with the expedition sent out by Sir Walter Raleigh in 1585. The commander was Sir Richard Grenville. A temporary settlement was made on Roanoke Island, now in North Carolina.

Hariot was a real scientist whose report covered the natural history of that time. He had little use for travellers' tales, but made an accurate survey of plant and animal life as well as geological conditions in the New World. After returning to England he published his report in London in 1588. This is the first account in English of any section of the United States.

The book is divided into three parts. The first treats of "Marchantable commodities" in which Hariot mentioned various minerals and the occurrence of iron and copper. His report is confirmed by Governor Ralph Lane and by the mineralogist or "mineral man," (Captain Vaughan) who took part in the expedition.

The second part is entitled "suche commodities as Virginia is known to yeelde for victuall and sustenance of mans life." Here we have the

first description of the plant and animal life of old Virginia. One need not expect a systematic report from one who lived a century and a half before Linnaeus, but keeping in mind the day and the state of science, the fulness and accuracy of Hariot's narrative is notable. He names twenty-eight species of mammals, twelve of which he saw himself. He was the first to distinguish the American and European species of deer:

> "Deere, in some places there are great store: neere unto the sea coast they are of the ordinarie bignes as ours in England, & some lesse; but further up into the countrey where there is better feed they are greater; they differ from ours onely in this, their tails are longer and the snags of their hornes looke backward."

This brief account was not replaced by a better one for nearly two centuries. Of birds, he wrote:

> "*Turkie cockes* and *Turkie henness*: *Stock doves*: *Partridges*: *Cranes*: *Hernes*: & in winter great store of *Swannes* & *Geese*. Of al sortes of foule I have the names in the countrie language of four score and sixe of which number besides those that be named, we have taken, eaten, and have the pictures as they were there drawne with the names of the inhabitaunts of severall strange sortes of water foule eight, and seventeene kinds more of land foul, although wee have seen and eaten of many more, which for want of leasure these for the purpose could not be pictured: and after we are better furnished and stored upon further discovery, with their strange beastes, fishe, trees, plants, and herebes, they shall be also published.
>
> There are also *Parats, Faulcons, & Marlin Hawkes*, which although with us they be not used for meate, yet for other causes I thought good to mention."
>
> Sixteen different varieties of fish were listed.

Hariot also described the planting, sowing, and cultivation of maize, beans, pease, melons, pumpkins, and gourdes, and then gives this interesting account of tobacco:

> "There is an herbe which is sowed apart by its selfe & is called by the inhabitants uppowoc. In the West Indies it hath divers names, according to the severall places and countries where it groweth and is used: the Spaniardes generally call it Tobacco. The leaves thereof being dried and brought into powder; they use to take the fume or smoke thereof by sucking it through pipes made of claie into their stomacke and heade; from whence it purgeth superfluous fleame & other grosse humors, openeth all the pores & passages of the body: by which meanes the use thereof, not only preserveth the body from obstructions; but also if any be, so that they have not beene of too long continuance

> in short time breaketh them: whereby their bodies are notably preserved in health, & know not many greevous diseases where withall we in England are oftentimes afflicted."

In the final section of the book are observations on the geology of the area which are remarkably good considering the short time, less than a year, at the author's disposal and the obstacles to travel from the coastal island of Roanoke. Hariot distinguishes the coastal plain, the Piedmont, and the fall line. He notes varied crystalline rocks of the Piedmont and the good and abundant clay of the coastal plain for brick making. He speaks of the occurrence of iron ore in the Piedmont and of copper at some point beyond the limit of exploration. This information probably came from the Indians who used copper ornaments.

Hariot's Virginia is the first scientific effort by an Englishman in our colonial history. Enough has been said of the work to indicate its quaint flavor; the flavor of the man himself is largely lost. We can guess that he was a modest man by the very fact that in spite of his stature as a scientist he is little known. His best biographer is Henry Stevens of Vermont, who asserts that Hariot, after his return, worked on the same problems as Galileo. Although it is difficult to say which one actually invented the telescope, it seems that each independently made the invention.

Hariot was the constant companion of Sir Walter Raleigh and Henry Percy, ninth Earl of Northumberland during their years in the Tower of London. He collaborated with Raleigh in his *Historie of the World.*

Hariot was one of England's great scientists of his day. He died in 1621 and was buried in the churchyard of St. Christophers on the site of the Bank of England on Threadneedle Street. In any account of the earliest Virginia science the name of Thomas Hariot must occupy a prominent place.

Captain John Smith, along with his remarkable talent for leadership, has the distinction of being the first scientist of the Jamestown Colony. A *Map of Virginia, with a description of the Countrey,* published in Oxford in 1612, contains many scientific observations. Smith's Map is on the whole accurate and detailed. Like Hariot, Smith distinguishes coastal plain, Piedmont, and the fall line. His observations on soil types are the first made in the new land. He notes the relation between vegetation and soil: "The vesture of the earth in most places doeth manifestly prove the nature of the soile to be lusty and very rich." He was not deceived by: "These waters [from the mountains] wash from the rocks such glistering tinctures that the ground in some places seemeth as guilded, where both the rocks and the earth are so splendent to behold, *that better judgement than ours might have been perswaded, they contained more than probabilities.*"

The inference is plain. John Smith's own judgment is not persuaded that glistering tinctures and moskered shining stone in the stream beds are gold. Speculators in England learned to their sorrow that a shipload of such material had no more value then so much ballast.

Captain Smith in the brief compass of the first chapter of his book gives a great deal of new information about his "Ould Virginia." He was the first to describe the muskrat, raccoon, and flying squirrel. He notes the opossum's pouch. He catalogues twenty-five kinds of fish and shellfish. Among birds he includes blackbirds with red shoulders.

He mentions the common types of trees such as oak, ash, walnut, elm, mulberry, and various fruits and vines. He describes the "chechinquamens" and "putchamins" (chinquapins and persimmons). It seems strange to find so little mention of pine, which must have been abundant. Another omission among cultivated plants is tobacco, though he devotes considerable space to Indian methods of cultivation and utilization of maize. Though untrained in scientific writing Smith shows himself a keen observer, whether of natural history or of the manners, religion, and government of the Indians.

Three years after publication of Smith's Map Ralph Hamor the younger extended the list of native animals in his *True Discourse on the Present Estate of Virginia.*

A considerable figure in seventeenth century science in Virginia was the Reverend John Clayton, thought to be a cousin of the later and greater botanist of the same name. This Clayton was a man of scientific culture. He published in the Philosophical Transactions of the Royal Society, 1693, '94, a creditably full annotated catalogue of mammals, birds, and reptiles. He was especially interested in fossils. His description of a fossil whale is well known. He also described shark's teeth and many fossil shellfish. His attitude toward the latter was similar to that of his scientific contemporaries in England, where there was uncertainty as to their being the remains of animals or just figured stones.

These and other seventeenth century Englishmen contributed something to American science, but of them all, perhaps only Hariot can be called great. The period was not favorable to the development of science in America. Persistently beset by danger on all sides and the struggle to exist, the colonials had little opportunity to develop an American science before the eighteenth century. At a time when England and the Continent of Europe were experiencing the age of enlightenment, one man stands out on the American scene, John Banister.

We have seen that the earlier scientific writers were historians rather than scientists. John Banister, however, was an exact observer; and though

remembered chiefly as a botanist, was the first to investigate and report intelligently on the mollusks and insects of North America. In a paper transmitted to the Royal Society in 1693 he refers to drawings of ten or twelve kinds of land snails and six of freshwater mussels, probably the first zoological paper of scientific importance to go from the American Colonies. While scientific thought and investigation begin with Thomas Hariot, accurate scientific knowledge of plant and animal life finds its first real pioneer in John Banister.

This eminent naturalist is supposed to have been a native of England and a graduate of Magdalen College, Oxford. He was living in Charles City County, Virginia, as early as 1678 and for at least fourteen years carried on serious scientific studies of the plant and animal life of Virginia. The belief that Banister was really a native Virginian has some support in two documents on record in the court house of Charles City County. On January 12, 1658, a certain John Burton demised to "Lieutenant John Banister one plantation at Bonaccord which I hold by lease for thirteen years or upward to come." A John Banister is listed as having served on a jury in the County record books, 1655-1666, p. 219, dated July 2, 1659. This Banister is thought to have been the father of John the naturalist. Whether young John Banister was a native of Virginia or England American natural history actually begins with him. He marks the real beginning of a native science. He was a tireless investigator of the plant and animal life of Virginia.

Very little is known of Banister's personal life. He was a clergyman of the Church of England and patented land on the Appomattox River. There is evidence that he married a "young widow" in 1688. He was a friend of the first William Byrd and was highly regarded by those who knew him. He is known to have spent much time in scientific pursuits. William Byrd mentioned Banister in several of his letters as a neighbor and friend. In a letter to Jacob Bobert, keeper of the botanical gardens and Sherardian Professor of Botany at Oxford University, Byrd says:

"Virginia, May 20th, 1684.

To Jacob Bobert, Per Wynne.

Sir, — Yours of the 9th of January and the 28th of Sept'r both came safe to my Hands, with your acceptable present of roots and seeds. The Iris, Crocus, Tulips, and anemones flowered this year. The Seeds (I fear) were heated in the hould of the Ship, but very few of them coming up.

If you send anything to Mr. Banister, you had best send it up to Messrs. Perry & Lane, merchants in London to bee sent to mee, who will send anything from the middle of July to the

last of Oct'b'r when there is allways a ready passage. If you send roots and seeds you had best write on the box to bee put in the Hould.

I wish it lay in my power to doe you and Mr. Banister any acceptable service. I'll assure you none should bee more ready than your obliged friend and servant.

W(illiam) B(yrd)"

In another letter to Bobert he gives this interesting side-view of Banister:

"I gave your Token to Mr. Banister who is marryed to a Young Widow. I did expect him at my home last weeke, but hear since that he was not very well. . ."

The first William Byrd was a capable amateur botanist. His interest in trees and plants was doubtless heightened by his friendship with Banister.

Proof of Banister's ability as a naturalist is found in the testimony of his contemporaries and in his correspondence with many eminent naturalists of the seventeenth century, notably John Ray, Bishop Compton, Sir Hans Sloane, and Martin Lister. He sent many specimens and drawings of New World plants to these men. In 1680 he sent Petiver a collection of fifty-two species of insects, which with his observations and notes by Petiver, were later communicated to the Royal Society. Among these insects many forms are recognizable, notably the mudwasp, seventeen year locust, Cimex, cockroach, firefly, Elater, and tobacco moth. He seems also to have drawn and described several phases of the life history of the ichneumon fly.

Banister had in his possession in 1686, and exhibited to an English traveller, large bones and teeth of fossil mammals from the interior of Virginia. These are among the first fossils of which there seems to be any record in North America. George Brown Goode has suggested that these were the bones of *Megalonyx Jeffersonii*, the giant sloth subsequently discovered by Thomas Jefferson.

In 1687 Banister sent his list of Virginia plants to the English botanist John Ray, who spoke of him as "eruditissimus vir et consummatissimus botanicus." Lister termed him "a very learned and sagacious naturalist." The historian John Lawson of North Carolina remarked that "had not the ingenious Mr. Banister (the greatest virtuoso we have ever had on this continent) been unfortunately taken out of this world, he would have given the best account of the plants of America of any that have yet made such an attempt in these parts."

Banister's zoological and botanical papers were published in the Philosophical Transactions of the Royal Society. His lengthy catalogue of Virginia plants, the first systematic paper upon natural history to emanate from America, was published in Ray's *Historia Plantarum*. His descriptions in this paper are generally accurate, and some have been called elegant.

The Banister River, flowing through Pittsylvania and Halifax Counties and meeting the Roanoke by way of the Dan, and the small Virginia village of Banister, were named for John Banister. John was nominated an original trustee of the College of William and Mary. He was considered by that institution to be one of the forty-two most distinguished men of Virginia before the American Revolution and his name is engraved as such on the mace of the College. Linnaeus named the genus *Banisteria* of the tropical Malpighia family for him. His early death prevented the completion of a proposed *Natural History of Virginia*, for which work Ray says he was in every way qualified. After Banister's death his papers were transmitted to Bishop Compton, and his herbarium to Sir Hans Sloane, with whose collection it became a part of the nucleus of the British Museum.

The accounts of Banister's death vary with each reporter. One says that he was accidentally shot; one that he fell from a cliff in pursuit of his objective; and a descendant that he was struck by a falling tree. We have no way of knowing which version is correct. We do know that he died about 1692 somewhere on the Roanoke River while on a botanical expedition. He sleeps somewhere in the sweet Virginia soil, possibly in the soft sands of the tidewater where he made his home, or in the blue hills of the Piedmont, or on a winding bank of the Roanoke as it glides through Southside Virginia. No one knows. Nothing he owned or wrote is left, but the first naturalist of America, the first martyr to science in the New World, has no need of memorials.

History of Virginia's Commercial Fisheries[1]

NEGLECTED HISTORICAL RECORDS THROW LIGHT ON TODAY'S PROBLEMS

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Virginia Fisheries Laboratory, Gloucester Point

As the Susan Constant, the Godspeed, and the Discovery made their way through Hampton Roads and up the James River toward Jamestown in 1607, they traversed a 15-mile stretch of water that was to play an important part in the history and economy of Virginia. Beneath these pleasant waters, and sometimes forming reefs that were awash at low tide, lay the most prolific natural oyster beds in the world. Three hundred and fifty years later these grounds still provide the seed that makes Virginia's oyster industry supreme, producing about one-quarter of the nation's supply of these delicious mollusks.

Had they been free to harvest at will the oysters and other seafoods that were so abundant round these shores, the colonists might have escaped some of the dietary troubles that contributed to their hardships. But ignorance, lack of experience, and other things conspired to deny these benefits to them. Today, though ignorance and self-interest still hamper the full utilization and management of these resources, we can see ever-increasing improvement. Despite dire predictions to the contrary, these resources have continued to renew themselves, and there is no reason why they should not do so forever if exploited wisely.

Several major problems face Virginia's seafood industry today. It is commonly believed that these troubles would disappear if the biological supply could be controlled. For this reason, the traditional approach to fishery management has been through biological research, and except in a few fisheries, the results have not been entirely successful. Although the historical record of Virginia's marine fisheries is brief and incomplete, the lessons to be learned from even this fragmentary history have never been fully explored. Perusal of the available records suggests that the situation is far more complex than popular opinion would suppose, and that the study of history, economics, and sociology, among others, must take equal place with biology if fishery investigations are to serve their full purpose.

[1] Contributions from the Virginia Fisheries Laboratory, No. 70.

SOURCES OF HISTORICAL MATERIAL

No complete historical account of Virginia's fisheries exists, although Pearson (1942a, b, 1943a, b, c, d) and Wharton (1948, 1949, 1957) have published excellent summaries of available knowledge on certain phases of the industry. The reports of the U. S. Commission of Fisheries and its successors the Bureau of Fisheries and the U. S. Fish and Wildlife Service, and the reports of the Virginia Commission of Fisheries, contain many references to the seafood harvest. The statistical reports of the U. S. Government have contained relatively detailed records of Virginia's fisheries since 1880, but prior to 1929, when annual summaries began, only eleven years, separated by irregular intervals, are on record. Before 1880, information on Virginia's fisheries must be culled from occasional reports, individual diaries, and the like. For example, the journals of George Washington contain numerous references to his fishing activities, conducted primarily to provide food for his slaves, although he shipped quantities of seafood to the city markets. No large commercial fishing industry existed in Virginia before the War between the States. It is the history of the period after 1865, when the fisheries as we know them today were evolving, that provides the perspective in which current problems should be viewed.

CHARACTERISTICS OF THE PENINSULA FISHERIES

Written for publication on the 350th anniversary of the landing at Jamestown, this article most appropriately should deal only with the fisheries of the historic peninsula bounded by the James and York Rivers. Unfortunately, the records are not sufficiently detailed to permit this separation from the fisheries of Virginia as a whole. But the fortunes of the fishing industry on the Peninsula are so strongly linked with those of the entire State that the lack of this specific information is not a serious handicap.

The Peninsula fisheries have their own peculiar characteristics, of course. In 1945 and 1950, although the landings in this area accounted for only 10 to 20 per cent of the total weight of raw fishery products landed in Virginia, this represented 15 to 25 per cent of the total value. The principal reason for this relatively great unit value is the almost complete absence from these landings of the relatively cheap menhaden, from which oil and meal are manufactured. On the other hand, the fisheries of the Peninsula are unusual in that they include almost all the State's landings of turtles and one-third to one-half of the catfish catch.

The oyster has always been the major product of Virginia's seafood industry. Indeed, its scientific name, *Crassostrea virginica*, "the thick (or heavy) oyster from Virginia," signifies that this is the most favored spot

along our eastern coast for oyster growth and fattening. The little port of Menchville, not far from Newport News, harbors most of the fleet of tongers that reap the State's great seed-oyster harvest.

The major development of the fisheries for blue crabs and migratory food fishes has taken place since the turn of the century. Before 1900 the lack of modern methods of preservation, the difficulty of transportation, and the lack of mechanization in the fishing fleet, restricted these seafoods to local markets. Today, one-third of all the blue crabs landed in the United States come from Virginia.

The latest and earliest comparable catch records available from the U. S. Fish and Wildlife Service are summarized in Table I. By value, oysters made up about two-thirds the total in 1890, one-half in 1954. Menhaden, the second most valuable single species in Virginia in 1954, were also fairly important in 1890, but the crab fishery, of minor importance in 1890, was third in value in 1954. In order of value, the important food fishes in 1890 were the shad, the alewife, and the sea trout; in 1954 the scup or porgy had captured first place, followed by the shad, croaker, sea bass, alewives, spot and sea trout.

TABLE I. VIRGINIA FISHERIES LANDINGS, 1890 AND 1954

Species	1890		1954	
	Weight in pounds	Value in 1954 dollars	Weight in pounds	Value in 1954 dollars
Oysters	40,453,000	8,416,000	21,225,000*	9,840,000
Blue crabs	3,025,000	184,000	34,561,000**	1,638,000
Menhaden	107,342,000	476,000	284,933,000	3,670,000
Food Fishes	34,463,000	3,288,000	70,782,000	4,423,000
Miscellaneous			1,040,000	420,000
Totals	185,282,000	12,364,000	412,541,000	19,991,000

*Pounds of meat shucked from 4,474,000 bushels of oysters.
**Total weight of crabs before picking. As prepared for market this would represent about 4,452,000 pounds of crab meat, 2,091,000 pounds of soft crabs, and about 3000 tons of dried meal and scrap.

FLUCTUATIONS IN ABUNDANCE

From very early times fears have been voiced that these bountiful resources would be depleted, and their capacity for reproduction reduced. That these fears were not groundless is illustrated by the history of the public oyster grounds, the natural, self-sustaining oyster beds of the State, that were set aside for public use in 1892. The take of market

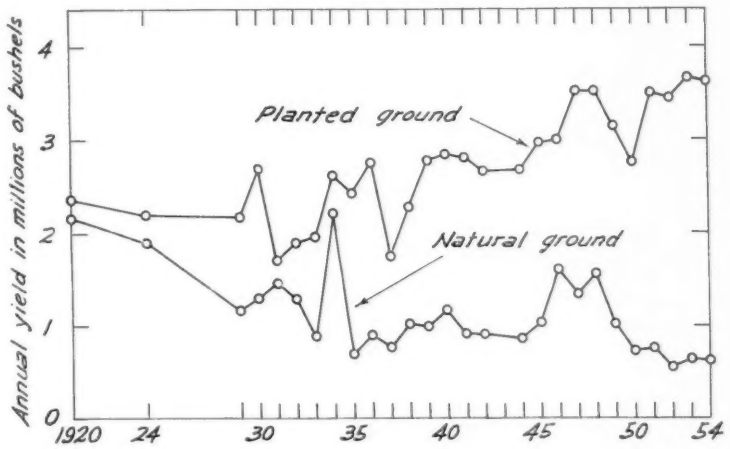

FIGURE 1. Annual landings of market-sized oysters in Virginia, 1920 to 1954.

oysters, that is, oysters three inches or more in length, from these grounds has declined steadily over the years (Table II and Fig. 1), but an approximately equal increase in the harvest from private grounds has held the total annual yield to a fairly constant level for the past 35 years. In 1858 it was reported that the oyster production of Chesapeake

TABLE II. PRODUCTION OF MARKET AND SEED OYSTERS IN VIRGINIA, AND TOTAL OYSTER PRODUCTION IN VIRGINIA AND MARYLAND, 1880 – 1954, IN U. S. STANDARD BUSHELS

Year	Virginia			Maryland
	Market	Seed	Total	Total
1880	....	....	9,549	13,809
1888	....	....	5,118	11,115
1890	....	....	8,483	13,614
1891	....	....	8,606	12,956
1897	....	....	9,810	9,452
1901	....	....	8,475	7,407
1904	....	....	10,632	5,771
1908	....	....	7,088	8,119
1912	....	....	8,668	7,179
1920	4,506	1,030	5,536	5,924
1924	4,102	1,982	6,084	5,541
1929	3,345	1,678	5,023	3,338
1930	3,994	2,248	6,242	3,055
1931	3,180	2,132	5,312	3,051
1932	3,198	2,050	5,248	2,550
1933	2,850	2,070	4,920	2,317
1934	4,833	2,090	7,742	2,913
1935	3,105	2,553	5,658	3,527
1936	3,673	1,180	4,853	3,402
1937	2,532	1,112	3,644	4,516
1938	3,314	1,234	4,548	4,146
1939	3,777	1,142	4,919	4,403
1940	4,026	1,289	5,315	4,264
1941	3,744	1,241	4,985	4,055
1942	3,569	981	4,550	2,974
1944	3,557	1,644	5,201	3,366
1945	3,897	1,498	5,395	3,254
1946	4,597	1,455	6,052	2,949
1947	4,857	1,104	5,961	2,799
1948	5,083	1,932	7,015	3,129
1949	4,154	2,248	6,402	2,924
1950	3,485	2,541	6,026	2,770
1951	4,263	2,866	7,129	2,868
1952	3,998	2,682	6,680	3,190
1953	4,293	4,077	8,300	3,342
1954	4,474	....	....	3,736

Bay was 20 million bushels (De Broca, 1865). This level of annual production was sustained until the early 1890's (Table II), but thereafter the harvest declined steadily. The drop has been much more pronounced in Maryland, where the annual crop in recent years has been only about one-quarter the amount harvested 60 years ago. Superficially, it would appear that the annual oyster crop in Virginia has declined only slightly in the same period. This is true when the seed-oyster landings are included (Table II), but a radical change in the seed-oyster industry has occurred in the past 100 years. Whereas in the nineteenth and early twentieth century Virginia seed consisted of large oysters shipped to northern waters, where they were replanted briefly and then marketed, today almost all Virginia seed is replanted within State waters. Therefore these same oysters now appear again in the records as market oysters. Thus, although in earlier years seed and market oysters together correctly designated the total Virginia harvest, more recently the total crop is represented by the market oysters alone. On this basis, it appears that Virginia now markets only about half the amount of oysters she formerly produced.

The supply of blue crabs, another seafood in which Virginia leads the nation, always has been erratic. In some years crabs are so abundant that the catch exceeds the demand; in others, so scarce that the industry suffers real hardship. Careful study of the history of the crab fisheries has produced no evidence that fishing operations or other human activities have influenced the capacity of the resource to renew itself, and it seems fairly obvious that the biological fortunes of the crab fisheries are determined in large part by natural forces. Certainly, within the past quarter-century, the catch has oscillated through several highs and lows (Van Engel, 1954; McHugh, 1955) and there is no reason to doubt that this condition has existed always (McHugh and Ladd, 1953).

The migratory fishes, the mainstay of Virginia's pound-net, haul-seine, and gill-net fisheries, exhibit a similar history of fluctuation. The high point in recent years was reached in the period 1944-1949 inclusive, when the average annual catch of food fishes within the Virginia waters of Chesapeake Bay was about 132 million pounds, greater than in any other 6-year period on record. But fishing in the Bay has not always been so good, and in the available records, the landings of many species exhibit considerable fluctuation. These changes were not entirely due to variations in abundance, it is true, for economic conditions and changing tastes play their part, as we shall demonstrate later. But newspaper files, official reports, and reliable fishermen of long experience are unanimous in their remembrance of the major shifts in abundance. Without a doubt, some species, especially sturgeon and shad, have declined steadily in abundance since the white man came. The striped

bass or rockfish also seems to have decreased in numbers, although there have been several unusually successful spawnings, notably in 1934, 1940 and 1942, that have produced temporary increases in fishing success. These three species return to the rivers each year to spawn, hence are particularly vulnerable to the effects of pollution, dams, and other human agencies. Yet the river herrings, apparently equally vulnerable, seem to be more abundant in recent years than ever before.

Recent declines in the landings of croaker and sea-trout, two of Virginia's most important food fishes, have been attributed to several causes, all associated with man's activities. But there is evidence also of large natural fluctuations in the success of spawning of both species, and the spot, which has similar habits, and is caught in large numbers by essentially the same fishing gears, has shown no parallel decline.

It is clear, therefore, that although the possibility of depletion by the effects of pollution, obstructions, or fishing operations should not be minimized, the great variations in abundance produced by natural forces must not be forgotten. Such natural fluctuations in abundance always will have sociological and political repercussions, and perhaps always will be confused with the effects produced by man.

RECENT HISTORY OF VIRGINIA'S FISHERIES

The reports of the Virginia Commission of Fisheries and the various fishery agencies of the U. S. Government, dating back almost to the middle of the nineteenth century, are often biased, full of conjecture completely unsupported by facts, and contradictory. Nevertheless, they present many interesting sidelights on the fisheries of their day and on the philosophy of the people engaged in them. The fishery statistics of the United States, published by the U. S. Government, contain a wealth of material, from which we have extracted the information on landings and landed values used herein. The average annual price per pound was derived by dividing the total recorded value for each species by the total recorded weight, and these figures were adjusted according to the wholesale price indices for farm products as published by the Bureau of Labor Statistics.

THE OYSTER

The commercial packing of oysters, an industry that began in Maryland in the 1830's, was not important in Virginia until after 1865. Growth of the industry was rapid, and near the turn of the century the annual production in Virginia alone reached 10 million bushels (Table II).

The per capita consumption of oysters in the United States 100 years ago was almost unbelievable by present-day standards. According

to De Broca (1865), in towns along the Atlantic coast, oysters formed a part of the daily food of almost every family. Large restaurants especially intended for the sale of shellfish were common everywhere, and in New York City alone there were more than 300 of these establishments. Oysters also were sold in small shops, and at stalls in the open street. In 1865, the consumption of oysters in New York City was almost seven million bushels. At that time the population of the city was less than 900,000 people, and the per-capita consumption therefore was almost 8 bushels a year, or 5 oysters per day, for every man, woman, and child in the city! If this rate of consumption had persisted, New York City alone would now consume about 61 million bushels of oysters each year, four times the present oyster production of the entire United States!

In the first few years of the twentieth century oystering in Virginia continued to expand. New oyster houses were put into operation each year, and by 1903, more than 8,000 licenses were issued for hand-tonging as well as several hundred each for patent-tonging and dredging. But in the season of 1907-1908 calamity struck, partly as the result of the depression that was just ending, but perhaps mostly from a pollution scare that reduced the demand. The details of this "pollution scare" are not complete in the records examined, but the passage of the pure food and drug act in 1906 undoubtedly laid the foundation, and the resulting restrictions on the marketing of oysters from polluted areas near the larger cities erected the first barriers to public acceptance of oysters. The 1908 report of the Virginia Commission of Fisheries states that the ban on Virginia oysters was not justified, and that this was the most unsatisfactory oyster season in many years.

By 1910 a substantial recovery had taken place, and it is said that the season of 1910-1911 rivalled 1907, the peak year before the "pollution scare" of 1908. This same report stresses an increased production of oysters from the natural grounds and a sharp decline in the acreage of ground under lease.

From the early 1900's the Commission became increasingly preoccupied with pollution problems. The prevailing attitude of the industry toward the then recent sanitation laws is undoubtedly echoed in the Commissioner's rather contemptuous reference to the "pure food craze." It is interesting to speculate on the effect that this attitude may have had on the demand for oysters. Later, however, the Commission took an increasingly serious view of the growing pollution problem, caused primarily by the discharge of untreated sewage.

The oyster industry continued to prosper, according to reports of the Commission, until the season of 1924-1925, when another pollution scare affected the market. In the fall of 1924 a health officer in Chicago

issued some general remarks on the purity of oysters. The ensuing publicity seriously affected oyster sales over the entire country. The report for 1925-27 stated that the setback was temporary, and that oysters again were in great demand and prices excellent. This optimistic view is not well supported by the published catch records, however, and it is significant that although the population of the United States had been increasing rapidly for some years, neither the production of oysters, nor the price, increased proportionately.

In the 1920's the conviction grew that a shortage of cultch was developing on the natural oyster grounds. A seafood survey commission, appointed by Governor Byrd in 1927, recommended a special tax on oysters to finance the planting of shell on these grounds. This plan was put into action in 1929, and "repletion" activities have become an increasingly important function of the Commission.

The 1929-1930 season was marked by a serious mortality in Mobjack Bay and the York River, when 75 per cent of the oysters on planted grounds died. Dr. H. F. Prytherch, assigned by the U. S. Bureau of Fisheries to investigate the catastrophe, was not able to identify the cause postively, which was hardly strange, for his investigations began well after the deaths had occurred. But his studies emphasized the importance of scientific fishery research, and in 1931, Dr. V. L. Loosanoff, now a leading authority on the oyster, was employed by the State. A year later Dr. Loosanoff's appointment was terminated for lack of funds, and Virginia conducted no marine research again for several years.

Reference to oyster drills or screwborers as a growing pest on oyster grounds within the Bay arose in the early 1930's. The inference was that these predators were responsible, together with over-exploitation, for the decline of many natural oyster grounds. In recent years, oyster drills have come to be recognized as a major pest on Virginia grounds.

A heavy strike of young oysters in the James River was reported in 1930. In the 1931-1932 season it was said that the supply of seed far exceeded the demand. It is not entirely clear whether this was caused partly by an unusually abundant supply, for the market for oysters in the depression years was poor, and planters apparently held their crops on the grounds rather than sell them at the low prevailing prices. Thus there was little ground available on which to plant seed, and probably little interest in further planting.

The oyster industry did not prosper in the 1930's. Heavy mortalities were reported in the winter of 1935-36, caused by unusually low temperatures, ice, freshets, and gales. The preceding winter apparently also had been severe, and the seed harvest in the James River in 1936-37 was unusually small in consequence. It is difficult, however, to escape the

conclusion that economic factors played a large part in the ills of the industry, for the demand for oysters certainly dropped during the depression. Excessive publicity given to the growing problem of domestic pollution also may have affected the market adversely.

In the late 1930's a research laboratory was established at Yorktown by the U. S. Government to investigate industrial pollution of oyster grounds in the York River. The investigation was financed partially by Virginia. Impressed with the value of scientific research, the General Assembly appropriated funds to establish the Virginia Fisheries Laboratory, which was inaugurated in 1940 at the College of William and Mary.

The season 1942-1943 was described as one of unprecedented prosperity for the oyster industry, and the period 1943-1945 was called the "golden age of the oyster business." The sudden burst of prosperity was caused by World War II with its stringent rationing of meat. The demand for oysters, and the price (Fig. 2), rose sharply, and this in turn led to substantial increases in the annual landings of oysters and in the acreage of ground under lease. At the close of the war the price fell as abruptly as it had risen, but the total crop of oysters continued to rise as the increased plantings, stimulated by the earlier high prices,

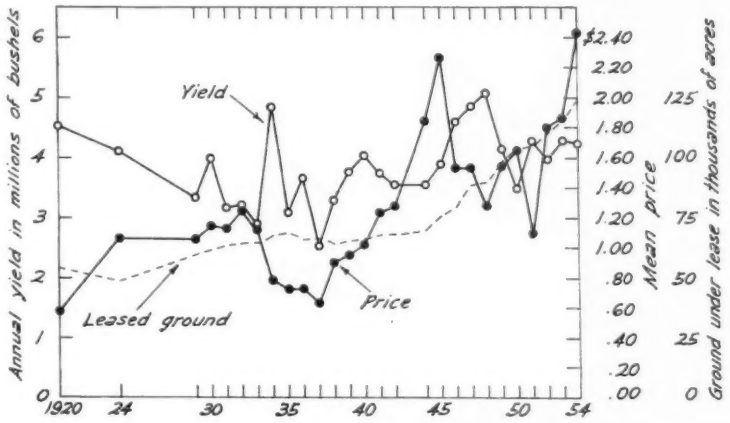

FIGURE 2. Annual landings of market-sized oysters in Virginia, 1920 to 1954, average annual price in dollars per bushel, and amount of planting ground under lease. Prices are expressed in standard dollars based on the Bureau of Labor Statistics wholesale price index for farm products.

reached market size. Probably this very abundance forced the price to its low point in 1948, for as production fell off again, the price rose. The steady increase in ground under lease probably reflects the continued decline in the harvest of market oysters from the natural grounds. Recent high prices can be attributed to a decreased supply caused by hurricane losses, disease, and poor growth in Virginia, and poor sets in northern waters, plus increased sales stimulated by the efforts of the Oyster Institute of North America, and by the development of new products, such as frozen oyster stew, frozen breaded oysters, and oyster sticks.

THE BLUE CRAB

As early as 1903 is was suggested that fishing activities might affect the future supply of crabs. The report of the Virginia Commission for that year stated that crabs were abundant, that the soft crab fishery was not harming the resource, but that danger lay in the lower part of the Bay, where the maiure females congregate and are exploited heavily by the early spring fishery. Again in 1911 the great abundance of crabs was mentioned, but the protection of sponge crabs was urged. By 1915 the situation had changed, as illustrated by the following quotation from the Commissioner's report:

> "The supply of crabs has now decreased to such an extent as to threaten the very existence of the industry, and fishermen are unanimously of the opinion that, unless proper protective legislation is enacted, the crabbing industry will soon be a thing of the past. We are of the opinion that the present scarcity of crabs is due directly to the failure to prevent the catching of ovigerous females which have not spawned."

One can recollect similar statements in recent years.

At its 1916 session, the General Assembly passed two laws restricting the take of crabs, one banning the capture of sponge crabs in certain months, the other establishing a minimum width of 5 inches for hard crabs. The 1916 season was a profitable one, and this was attributed to the effects of these laws. Nevertheless, a scarcity of crabs was noted again in the 1919-1921 report.

Detailed records of the success of crabbing have been kept since 1924-1925, with a gap in the period 1927-1930. These records show the *availability* of crabs to the fishermen, hence are more useful biologically than the total catch, which is affected by the demand, the number of fishermen, the weather, and other factors. The availability of crabs varies widely, the best season having been about five times as good as the poorest, but the general trend has not been downward, as reports often suggest. Alarming indications often appear in short-term records,

however, and the decline in the success of crabbing from the 1931-1932 high to the 1941-1942 low must have created consternation.

The Commissioner's report of 1931 mentions an "overabundance" of crabs. The 1932 report states that the great abundance had affected the price. Later reports recognize the gradual drop in crab production and repeatedly stress the opinion that sponge crabs should be protected. A sanctuary established in 1941, in the area where the spawning females congregate, has been credited by many with the apparent recovery of the resource, but in the ensuing period there have been equal numbers of good and poor seasons. Obviously, protection of sponge crabs is not the complete remedy that public opinion would suppose.

THE MIGRATORY FOOD-FISHES

Much has been written about the changing fortunes of the food fisheries, in Virginia as elsewhere in the United States. Characteristically, the story is one of depletion and hardship. The most important food fish of the early days was undoubtedly the shad. As pointed out above the shad was particularly vulnerable to the effects of dams and pollution, and though the catch in recent years is considerably smaller than it was at the peak of the fishery, the shad maintained its position as the most valuable food fish of Virginia until well into the present century.

As early as 1893 it was believed that Virginia's fishery resources were declining. The Commissioner of Fisheries (Wilkins, 1894) stated:

> "the question of greatest importance to our fishermen is the appalling decline in the number of the free migratory fishes that annually visit the waters of our State."

The 1903 report of the Virginia Commission of Fisheries stated:

> "It is an alarming fact that all of the finer varieties of fish are becoming less abundant."

Non-enforcement of the laws, and the "destructive" action of pound nets were cited as the major causes of the reported decline. Yet 1911 was described as the greatest year in Virginia seafood history:

> "Never before in our history have we seen such abundance of fin-fish ....."

But only four years later the prevailing opinion had changed:

> "Legislation, however, is badly needed for the protection of both fish and crabs, as the supply of some of our best varieties of fish has been decreasing for years . . . . Our fishing industry is in a very unsatisfactory condition . . . owing to the growing scarcity of many of our best varieties."

By the next year (1916) optimism had returned and the season was described as the most profitable in years, with all varieties, especially shad, more plentiful than usual, and prices good.

In 1923 it was stated that fish catches were down during the war and for two years after because manpower was lacking, but that the situation had improved. The fish catch received very little attention in reports issued during the 1920's, and this suggests that the threatened scarcity failed to materialize. The report for 1931 mentions an abundant food-fish supply. The newly-established trawl fishery in the ocean off the Virginia capes was expanding rapidly also, and in 1932 there were

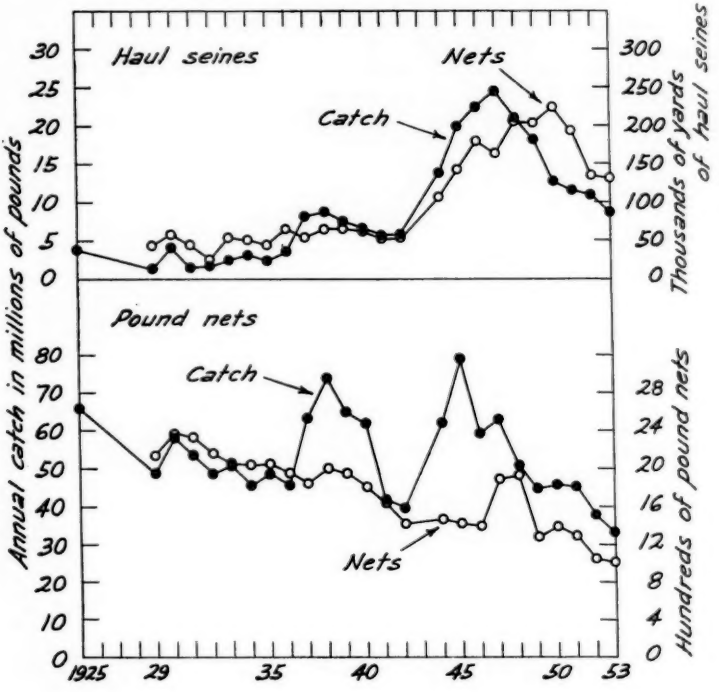

FIGURE 3. Annual catch by haul seines in Virginia, 1925 to 1953, and numbers of yards of nets licensed; and annual catch by pound nets for the same period, and numbers of pound nets licensed.

22 Virginia-owned trawlers in operation. Fish were abundant in 1932, but prices were low. In 1933 there was an excellent supply of croakers and other pan fishes in the Bay, but the ocean fisheries were not too successful and some boats dropped out.

By 1935, the increased cost of fishing gear, with no increase in prices, brought an unprofitable season to Virginia fishermen, and this condition persisted until the early 1940's. The trawl fishery continued to grow and show fair profits, however, probably because the gear was more flexible and efficient than the pound net. It was recognized that refrigeration and transportation problems placed Chesapeake seafoods in an unfavorable competitive position with fishery products from other areas. In 1939 it was pointed out that the demand for all Chesapeake seafoods had declined in recent years.

The war seems to have brought prosperity to all segments of the fishing industry in Virginia. A part of the increase in landings may well have been caused by an increased intensity of fishing stimulated by the unusually high prices, but there is little doubt that an increased abundance of croakers and perhaps some other species also contributed. The close correspondence between the number of pound nets and the pound-net catch, and the total length of haul seines licensed and the haul-seine catch.
(Fig. 3) suggest that there has been no progressive decline in the total catch abundance of all food fishes in Virginia since 1929. Unfortunately, however, when prices are high or abundance is temporarily increased, there is a certain time-lag in the response of fishermen. This delayed response, quite evident in figure 3, usually places the heaviest fishing effort at a time when abundance, or prices, or both, are already falling. The present trend seems to support the conclusion of Taylor (1951) that the ills of these fisheries have an origin that is primarily economic.

Another interesting feature of figure 3 is the increasing importance of the haul seine relative to the pound net. Pound nets are much more costly to install and operate, and they are subject to destruction by storms. Under these circumstances the haul seine may be a more effective gear in many localities. In 1925 only about 2 per cent of all food fishes landed in Virginia were caught in haul seines, but by 1950 this fishing gear accounted for 17 per cent of the food-fish catch.

Two recent events illustrate the reduced demand for Virginia food-fishes. When the shad catch rose in 1952 to almost 6 million pounds, only about half the average catch at the turn of the century, the price fell so low that fishing became unprofitable, and many fishermen dropped out well before the season ended. The improved catch of croakers in the spring of 1956 glutted the market so that the price fell as low as two cents per pound, and many fish were wasted for lack of a market.

Returns to former levels of abundance brought no benefit to the industry, probably because frozen products, such as fish sticks, from other areas have captured the market. Most Chesapeake fishes, because they are small and contain proportionately little meat, cannot be prepared economically as fillets, fish sticks or blocks. Perhaps a market could be developed for fresh-frozen, dressed panfish, emphasizing the best features of Virginia or Chesapeake varieties. A few progressive processors are testing such products.

HISTORICAL PERSPECTIVE ON TODAY'S MAJOR PROBLEMS

As Quittmeyer (1950) has pointed out, the chief preoccupation of Virginia's fishing industry has been with the physical supply, presumably on the assumption that marketing problems would work themselves out automatically. Perusal of historical records, however incomplete they may be, is apt to convince the reader that biological factors are not the only things affecting the welfare of the commercial fishing industry. Indeed; sociological, economic, and political forces often equal or exceed in magnitude the purely biological aspects.

The history of Virginia's fisheries over the past quarter-century provides an ideal example of the interaction of all the major forces that shape the well-being of her fishermen. The aftermath of the great economic depression is clearly marked on the record of seafood prices. The reports of the Commission of Fisheries continually stress the low prices that prevailed throughout the 1930's, and there is little or no evidence that the recurring complaints of hardship were caused by a biological scarcity of any of the important species. Indeed, there are several indications that the seafood supply was better than average, particularly in the second half of that decade.

Many of the recent complaints can be traced to the economic upheaval generated by World War II. The prices of all seafoods rose to unprecedented heights during the war, and reached a climax in 1945 (Figs. 2 and 4). Meat rationing probably was the chief cause of the unusual demand for seafoods, and the absence of controls on seafood explains the high prices, but it seems clear also that some of the major food fishes, especially croaker, were unusually abundant at the same time (Fig. 5). This combination of high biological productivity and unusually favorable economic conditions set the stage for the sociological fishery problems of the present day.

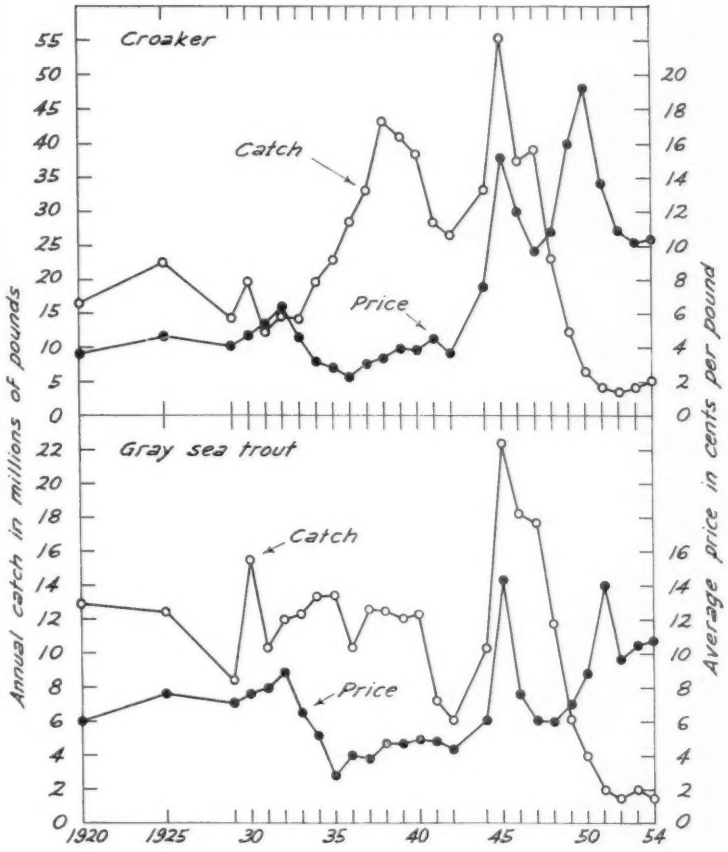

FIGURE 4. Annual catch of croakers and gray sea trout in Virginia, 1920 to 1954, and the average annual price in cents per pound. Prices are expressed in standard dollars based on the Bureau of Labor Statistics wholesale price index for farm products.

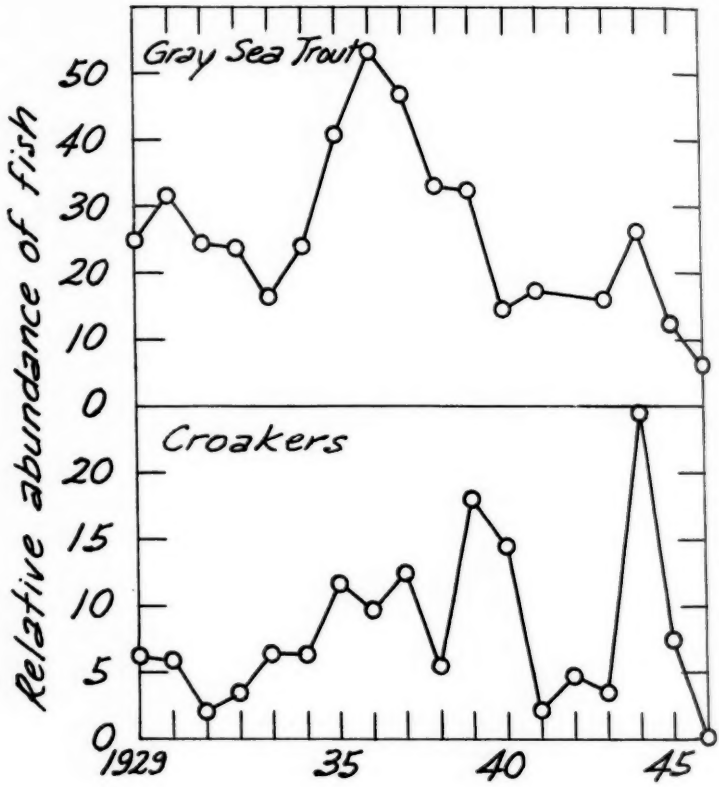

FIGURE 5. Relative annual catch of gray sea trout and croakers per net per day, for the period 1929 to 1946, in a series of pound nets fished in the ocean off the eastern shore of Virginia.

The high prices of the mid-1940's undoubtedly attracted men back into the fishing industry. As might be expected, however, there was a time-lag in the response to these favorable conditions. For example, as mentioned previously, the increase in numbers of pound nets and haul seines lagged two or three years behind the high prices and high catches. The delay may have been shorter if most of the available men had not

been serving in the armed forces. The result was that, in the period 1947-1950, perhaps the greatest effort ever expended in the history of Virginia's fisheries was exerted at a time when both the supply and the price had fallen from unusually and artificially high levels. One need not look back farther than 1945 to find the cause of most of today's fisheries problems. In the memory of fishermen, the war years are the "norm" to which legislation and scientific research will restore their fortunes, but in truth such bountiful times were the fortuitous result of an unusual set of circumstances that may not recur in their lifetimes nor in many generations to come.

Soon after the concurrent declines of prices *and* the catch of the major food-fish species in the years following 1945, the price of most species, particularly croakers and trout (Fig. 4), took an equally abrupt upswing. This probably occurred in response to the alarming drop in catches of both species. In other words the price responded this time to a biological scarcity of fish. But in the face of abruptly falling catches this did nothing to improve the economic situation of the industry. The abrupt reversal of this price increase, at a time when catches were still falling sharply, seems equally significant. The rapid growth of the frozen-fish industry, especially with the introduction of fish sticks, and the lure of attractive packages and ease of handling, coming at a time when croakers and trout from Chesapeake Bay were disappearing from the markets, probably was the final coup. That the demand for croakers fell off with the recent decline in abundance seems to be well illustrated in the current fishing season, when a sharp increase in catches has not brought the wave of prosperity that was anticipated. The bountiful catches of April and May 1956 soon brought prices to ridiculously low levels, and many fish were wasted for lack of markets. In competition with the relatively cheap and attractive frozen product from the northeast it seems almost impossible for the major Virginia species to regain their former position, although imaginative processors may regain at least a portion of their lost markets by adopting modern methods of preparation and selling, as some already have done.

An almost parallel, though not yet quite so disastrous, situation has existed in the oyster industry of the Peninsula and the State (Fig. 1). There has been a slow but steady decline in the harvest of market oysters, not only in Virginia, but along the entire coast, since the first reasonably accurate records were made in 1887. In Virginia, production reached a low in the 1930's (Fig. 2), and it is interesting that the unit price reached a minimum at the same time. According to Taylor (1951) it is significant that the price of oysters has not risen in response to the diminishing supply, especially as the human population has been increasing in numbers and in standard of living. The causes are undoubtedly complex, including changing tastes, a wider variety of competitive foods, and improved

methods of processing and marketing of all protein foods. A probable factor of importance is the rising cost of labor and materials in an industry that does not lend itself easily to mechanization. There is no doubt also that biological factors have contributed to the declining crop, for it is well known that the production of market oysters from the public grounds in Virginia, as elsewhere, has decreased considerably. But when the demand is sufficient, and prices warrant the effort, apparently the harvest can be increased considerably, as illustrated by the increase from about 3 1/2 million to over 5 million bushels in the 1940's. Unfortunately, it requires two or three years to raise a crop of oysters, and the increased crops stimulated by the high prices of 1945 came too late for profit. The sharp recession in production after 1948 speaks for itself. Good prices have prevailed for Virginia oysters since 1954 as a result of biological scarcity, and the development of new products, such as frozen oyster stew, promises a bright future for the industry. But high costs of production and the poor supply have cancelled out some of the benefits that the favorable market created. The margin of profit would be increased if oysters could be produced more cheaply. This goal may be achieved through more frequent harvesting and control of enemies and diseases. Another possibility, as Dr. Taylor has proposed recently, is to improve the quality and flavor of oysters, emphasizing the delicate natural flavor of the oyster rather than destroying it by excessive blowing or washing.

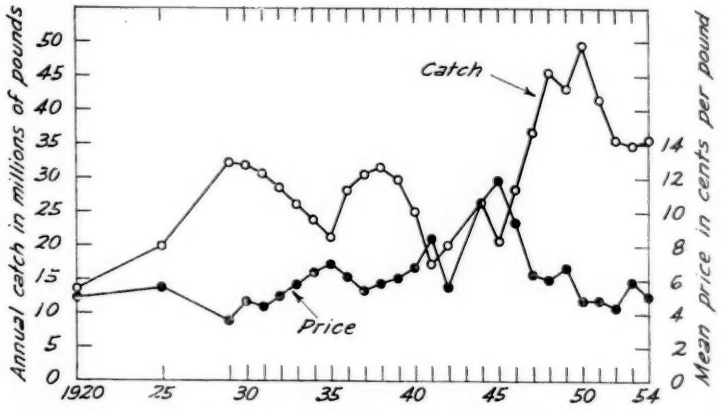

FIGURE 6. Annual catch of blue crabs in Virginia, 1920 to 1954, and the average annual price in cents per pound. Prices are expressed in standard dollars based on the Bureau of Labor Statistics wholesale price index for farm products.

In its main features, the blue crab fishery seems to have responded to changing biological and economic conditions in much the same ways as the oyster and the food fishes (Fig. 6). The annual catch reached maxima at the beginning of the 1930's, in the late 1930's, and in 1950, and each of these high points corresponds to a period of known biological abundance. In each period also, the price fell as the catches rose. Crab prices climbed during the war, to a maximum in 1945, but this coincided with a period of biological scarcity, and the total catch did not increase substantially in response to the favorable market. The three major dips in the annual catch, in the mid-1930's, the early 1940's, and the early 1950's each coincided with a period of relative scarcity of crabs, and the price responded accordingly. Biological research can help the crab industry by investigating availability in the waters of other states where crabs are relatively abundant. Perhaps scarcity in one region may be balanced by plenty in another. Improved methods of processing and preservation, particularly to speed up the costly and wasteful process of hand-picking, to eliminate shell from the picked meat, and to permit storage in times of great abundance, would benefit the industry.

The menhaden is not used as food for humans, hence its economic status is governed by an entirely different set of forces. We have not considered this fishery in any detail here, because menhaden are not of any importance directly to the Peninsula. But it is worth noting that the menhaden industry has profited from technological advances, which are continually developing new uses for the oil and scrap, improving the efficiency of the processing operation, and finding uses for by-products formerly wasted. The price of menhaden, as computed from the U. S. Fish and Wildlife Service records, has not exhibited the major oscillations characteristic of all the seafood species, and it is particularly interesting that no boom in prices developed during World War II. Superficially, it would seem that the menhaden fishery in Virginia is in a much stronger economic position than any other marine resource, although it is still subject to the effects of fluctuating biological supply. A thorough study of the history of this fishery in all its aspects might provide valuable lessons for the improvement of all our fisheries.

SUMMARY AND CONCLUSIONS

The recent historical record seems to explain very clearly current pessimism as to the condition of Virginia's marine fisheries. Artificially high prices during the last war created a temporary period of prosperity, and the illusion unfortunately was heightened by an unusual abundance of some of the migratory food fishes, especially croaker and trout. An equally artificial condition developed at the close of the war, when both prices and the biological supply of these fishes fell rapidly.

Another important factor which has narrowed the margin of profit in most branches of the seafood industry in recent years has been the sharply rising cost of labor and materials. Many operations in the catching and processing of seafoods still require hand labor, and mechanical substitutes are slow to come. The producers of most Virginia food fishes also have suffered from competition by the cheaper and more attractive frozen fillets and fish sticks from the northeast. The demand for oysters and blue crabs perhaps also has been supplanted to some extent by the rapidly-growing shrimp industry.

Biological research, to be of significant economic value to Virginia's fisheries, eventually must point the way to reduced costs of production. Recent findings by the Virginia Fisheries Laboratory, that oyster yields may be improved by more frequent harvesting, are a step in this direction. Predictions of blue crab and food-fish abundance also might aid efficient harvesting of these resources. The importance of basic biological research in achieving this objective cannot be overemphasized. Practical solutions to these many problems will depend on a thorough understanding of the habits of marine animals and their reactions to the environment. This basic information also is needed urgently to guard against the growing threat of industrial pollution.

But careful study of the history of the fisheries, incomplete though the record is, scarcely can fail to impress the reader with the importance of economic and sociological forces in shaping the welfare of the industry. Nowhere is this truth more apparent than in the important fishing State of Virginia. Yet fishery research everywhere has traditionally emphasized the biological aspects of the industry's problems, and when economic problems have been investigated, they have been concerned almost exclusively with the technical aspects of fishing or processing.

The concept of fishery research as a method of obtaining the maximum sustained (or equilibrium) yield of each useful product of the sea is not adequate so long as this definition embraces only the biological factors. But the other important factors can be included without rewriting the definition. The objectives of fishery research are not in doubt, but the means of attaining the desired ends through scientific investigation perhaps never have been clearly nor completely stated.

Virginians sometimes are criticised for their preoccupation with past events. It is perhaps appropriate that a consideration of historical matters, in this most historic of all the States, should lead to a broader understanding of a very pressing modern problem — the efficient utilization of a bountiful natural resource, and the economic and social stability of the people who use it for business and for pleasure.

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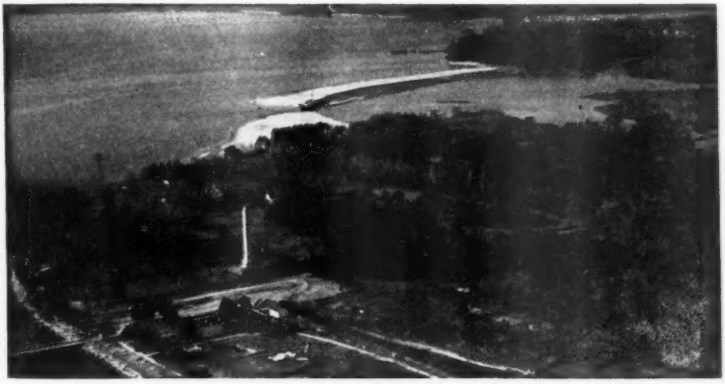
Physicians at Early Jamestown

SIDNEY S. NEGUS

Medical College of Virginia, Richmond

Prior to the establishment of the first permanent English settlement in North America at Jamestown, Virginia, on May 13, 1607, attempts had been made by Sir Walter Raleigh and others to found colonies on the coast. Although these early colonizing attempts failed, the explorers had named the territory Virginia in honor of the virgin Queen Elizabeth, and had brought back home such glowing reports about their adventures that the London Company was influenced to organize an expedition to this new country in 1606. Among these earlier unsucessful explorers was Captain Bartholomew Gilbert. He anchored in the "Chespian Bay in the country of Virginia" in 1603, the year that Queen Elizabeth died, and sent ashore a landing party of five, among whom was the English "surgeon" attached to the fleet. The little party fell into an Indian ambush and perished to a man. If this recorded history is correct, the first English physician to land upon the American continent, and the first to lose his life there in line of duty, was the ship's surgeon, Henry Kenton.

When the ships of the London Company, with their band of 105

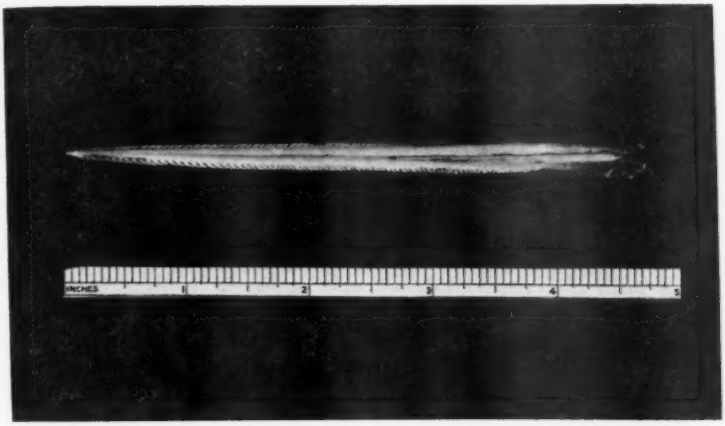


THE SITE OF JAMESTOWN

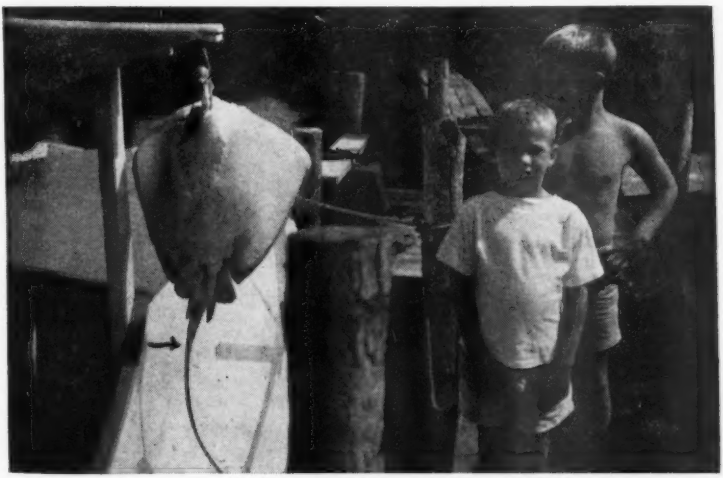
In the Background is Glasshouse Point, the Location of Festival Park — Center for the Jamestown Festival of 1957.

adventuresome colonists, landed in the marshy lowlands on the Virginia coast, there was no physician aboard. If there had been, the London Company's warning, "neither must you plant in a low or moist place because it will prove unhealthful," might have been heeded. This was the Company's fault, however, because it reckoned wrongly. It evidently calculated that wounds and injuries would be the problems of these pioneers — not sickness — so two "chirurgeons" were sent along, Thomas Wotton and Will Wilkinson. They probably were the typical "barber-surgeons" of that day, but of this there is no historical proof. Nothing is known about Wilkinson except that his name was included in the list of planters. Wotton was probably the "gentleman chirurgeon." He was praised highly by Captain John Smith in the summer of 1607 for his "skilled diligence" in treating the illnesses of Smith and two other planters. It is known that Wotton was with the colony for two years. What became of him after that is unknown.

In January of 1608, 120 additional settlers including the first two women colonists "Mistresses Forrest and Anne Buras, her maide," reached Jamestown. They found only forty of the original planters remaining! Fortunately, in this new group, there were a physician (Dr. Walter Russell), a chirurgeon (Post Ginnat), and two apothecaries (Thomas Field and John Harford). They were badly needed and so were the medical supplies which they brought with them. The original colonists had been weakened by their five-month voyage from England and the summer of 1607 had almost wiped out the settlement. Its wretched plight was described by George Percy and originally recorded by Samuel Purchas in 1625: "Our men were destroyed with cruell diseases as swellings, fluxes, burning fevers and by warres, and some departed suddenly, but for the most part they died of meer famine. There were never Englishmen left in a forreigne countrey in such miserie as we were in this newly discovered Virginia. — Our food was but a small can of barlie sod in water, to five men a day, our drinke cold water taken out of the river, which was the destruction of many of our men. Thus we lived in this miserable distress, not having five able men to man our Bulwarkes upon any occassion. If it had not pleased God to have put a terrour in the Savages heart, we had all perished by those wild and cruell Pagans, being in that weake estate as we were: our men night and day groaning in every corner of the Fort most pittiful to heare." Captain John Smith's "True Relation," which is said to be the most important narrative of the earliest Colonial days in America, has this recorded: — "Our extreme toil in bearing and planting pallisadoes, so strained and bruised us, and our continual labor in the extremity of the heat had so weakened us, as were cause sufficient to have made us as miserable in our nature tember— And now where some affirmed it was ill done of the Councel to send forth men so badly provided, this incontradictable reason will shew them



The Barb of a Stingray's Tail. Such a Barb was Responsible for what is Probably America's First Medical Case History.



A Stingray Caught by Dr. Russell V. Bowers of Richmond Near Spot Where Captain Smith Got into Trouble with One. The Boys are John and Daniel Bowers. The Arrow Points to the Barb.

plainely that they are too ill advised to nourish such il conceipts. First the fault of our going was our owne. What could be thought fitting or necessary wee had, but what should wee find, what wee should want, where wee should bee, we were all ignorant, and supposing to make our passage in two months, with victuall to live, and the advantage of the spring to work: we weare at sea 5 monthes, where we both spent our victuall and lost the opportunity of the time and season to plant."

Doctor Walter Russell was the first physician, as distinguished from a chirurgeon, to come to this country to live in an established settlement. He contributed the first literary effort of an American physician, the earliest of early American fish stories. It seems he was on an exploring trip in Chesapeake Bay with Captain Smith in June of 1608. "But it chanced," wrote Russell, "the Capitaine taking a fish from his sword (not knowing her condition), being much of the fashion of a Thornebacke with a longer taile whereon is a most poysoned sting 2 or 3 inches long, which shee stroke and inch and halfe into the wrist of his arme; the which in 4 houres, had so extremely swolne his hand, arme, shoulder and part of his body, as we all with much sorrow concluded his funerall, and prepared his grave in an Ile hard by (as himselfe appointed) which then wee called Stingeray Ile, after the name of the fish. Yet by the helpe of a precious oile, Doctor Russell applyed, ere night his tormenting paine was so well asswaged that he eate the fish to his supper; which gave no less joy and content to us, then ease to himself." Thereby Stingray Point, near Deltaville, Virginia, got its name.

Russell was not with Smith on the second expedition up the bay later in 1608. Instead, Anthony Bagnall, a surgeon or chirurgeon went along – probably because the captain's stingray wound needed surgical rather than medical attention. Not much is known about Bagnall except that he was surgeon at the fort and for settlers at Jamestown and vicinity for a brief period beginning in 1608. Both Doctor Russell and Bagnall could not have been in the colony long because when Captain Smith, the first president of the Virginia Company, was injured by the explosion of some gunpowder in 1609, he had to set sail for England to secure treatment "because there was neither chirurgeon or chirurgerye in the fort." The severity of Smith's burn is still a historical question mark – he may have wanted to sidestep the Jamestown brawls and his shaky existence there. His administration was considered a cruel one by his enemies who did all they could to get rid of him.

When Lord Delaware (Thomas West) came to Virginia in June of 1610 to take over where Smith left off, he brought with him a physician and scientist of parts–Dr. Lawrence Bohune. He was the first physician general of the London Company appointed for service in the Jamestown colony. He might be considered the first research scientist to join an

Lord Delaware, Successor of Captain John Smith. Because of America's First Noted Case of Scurvy, He Had to Leave Jamestown in Less than a Year.

established settlement in America. Finding sickness so prevalent and medical supplies dwindling, he began investigating the medicinal properties of such nature plants as sassafras, and rhubarb, and gums of the local trees. His experiments are among the first of a scientific nature to be recorded in the Jamestown colony. Health conditions at the time were so serious that in July of 1610 Lord Delaware wrote the London Company in part as follows: – ". . . Dr. Bohune, whose care and industrie for the preservation of our men's lives (assaulted with strange fluxes and agues), we have just cause to commend unto your noble favours; nor let it, I beseech yee, be passed over as a motion slight and of no moment to furnish us with these things . . . since we have true experience how many men's lives these physicke helps have preserved since our coming, God so blessing the practice and diligence of our doctor, whose store has nowe grown thereby to so low an ebb, as we have not above three weekes physicall provisions."

Shortly after Lord Delaware's arrival at Jamestown, he became ill. A portion of his report about his several maladies to the London Company is of interest because it describes well the horrible health conditions which must have prevailed generally among the early Virginia colonists. He wrote: "Presently after my arrival in James Towne, I was welcomed by a hote and violent Ague, which held mee a time, till by the advice of my Physition, Doctor Lawrence Bohune (by blood letting), I was recovered. That disease had not long left me, til (within three weeks after I had gotten a little strength) I began to be distempered with other greevous sicknesses, which successively and severally assailed me: for besides a relapse into the former disease, which with more violence held me more than a moneth, and brought me to great weaknesse, the Flux (dysentery) surprised me, and kept me many days; then the Crampe assaulted my weak body, with strong paines; and afterwards the Gout . . . afflicted mee in such sort, that making my body through weaknesse unable to stirre, or to use any manner of exercise, drew me upon the disease called the Scurvy; which though in others it be a sickness of slothfulnesse, yet in me of weaknesse, which never left me, til I was upon the point to leave the world." Not feeling so well (!) and instead of leaving the world, Lord Delaware left Jamestown in March of 1611 for the West Indies which was then noted for its healthful baths and food. He selfishly took Doctor Bohune with him and the latter probably never got back to Jamestown. The winds didn't blow right so they landed in the Azores where, wrote Lord Delaware, "I found help for my health, and my sickness asswaged by means of fresh diet, and especially of Oranges and Lemonds, an undoubted remedy and medicine for that disease, which lastly, and so long, had afflicted me." This statement is of special interest because it was not until 1928 that is was definitely proved by Szent-Gyorgi that there was a specific chemical

in citrus juices – now known as ascorbic acid or vitamin C – that would cure scurvy.

Doctor Bohune was known to be a shareholder in the London Company and quite a business man on the side so probably until March of 1622 he was occupied elsewhere. It is definitely recorded, however, that in December of 1621 he was appointed Physician General of the Colony. He set sail for Virginia with 85 immigrants early in 1622. In March, "while nearing the West Indies to obtain water, they fell in with two large ships who feinted to be Hollanders until they had secured the advantage of position, when they broke the Spanish colors and fired upon the English ships. The unequal combat continued for six hours with the most desperate courage on the part of the English; and then they beat off the enemy with the loss of the latter's captain, making their skuppers run with blood, coloring the sea in their quarter." Dr. Bohune was killed in this heroic defense while encouraging the crew to resistance. Dr. Wyndham B. Blanton of Richmond, Virginia, the authority on the history of medicine in Virginia, puts it this way: "So perished one of the most colorful of early Virginia doctors, a man of talent, of an investigative nature, full of robust enthusiasm for the sea and for adventure."

The London Company soon appointed Dr. John Pott to succeed Dr. Bohune as physician to the colony of Virginia. He landed in Jamestown in 1322. Dr. Richard Townsend is known to have come along as his apprentice and Joseph Fitch as his apothecary. Dr. Pott, mixing his medicine with politics and business, got into trouble right away. He managed to become Governor of the colony in 1629 but that lasted only a year. Sir John Harvey, his bitter enemy, succeeded him and immediately had Pott arrested for pardoning a murderer, holding cattle not his own and killing hogs belonging to other people. He was convicted of the latter but his sentence was suspended because he "was the only physician in the Colony skilled in epidemical diseases." Mrs. Pott set sail for England and was influential in having her husband pardoned by King Charles. Doctor Pott retired from all public life, moved inland a few miles and built a home which he called "Harrop." The fact that the physician to the Jamestown Colony had chosen this new location seemed a convincing indication of its healthfulness and it wasn't long before a village was built around "Harrop." It was later given the name of Williamsburg.

From the time that Doctor Bohune left the colony in 1611 until Doctor Pott arrived in 1622, there must have been physicians at the Jamestown Colony, but historical records of that day reveal few of their names. It is known that a Reverend Robert Pawlett came to Virginia in 1619 as a preacher, surgeon, and physician but little is known about his activities. There was also a Dr. William Norton who, according to Captain Smith,

"freely imparted to all gratis, but most bountifully to the poore." He was massacred by the Indians in 1622. Then there was a "Master Cloybourne the Surgian" who arrived in Jamestown in 1621, and Dr. William Rowsley who practised only a short time in the colony. The earliest tombstone record (1618) of a physician who had died in this country was found in Stafford County and marked the burial place of a Dr. Edmond Helder. Nothing is known about his life at Jamestown.

Doctor Blanton in his authoritative book, "Medicine in Virginia in the 17th Century" (The William Byrd Press, Richmond, 1930), has this to say about medicine during the regime of the London Company, which ended in 1624: "Throughout the remaining years of the century Virginia had many physicians and surgeons, most of them home grown, self educated, or products of a local apprenticeship. There were probably none comparable in training and education to the men sent over by the London Company before 1624." In the 1620's, because of this fact, the Jamestown settlers had become fairly well "seasoned" to Virginia vicissitudes and were able to send food supplies to the Plymouth Colony which was having difficulties comparable to those of Captain Smith and his planters in 1607 (The Virginia Magazine of History and Biography, April, 1954). According to Dr. Samuel Eliot Morison, Jonathan Turnbull Professor of History at Harvard University, "The first succor the Plymouth Colony had, in their straits of semi-starvation, came from the Jamestown Colony."

Dr. Maurice Bear Gordon, in his comprehensive book, "Aesculapius Comes to the Colonies" (Ventnor Publishers, Inc., Ventnor, N. J., 1949), has devoted much of its introduction to the powerful influences of the Indians on the practice of medicine in early Jamestown days. Their physical drugs included herbs, animal products, leaves and barks. They had empirical remedies, tied in with religion and animal worship, for all their diseases except the contagious ones introduced by the white man. Those exacted a deadly toll. Physicians of earliest colonial days often used successfully the remedies of the Indian medicine men.

It may perhaps be appropriate to close this sketchy article about early Jamestown physicians with the answer to a question which is often asked us at the Medical College of Virginia in Richmond about the sculpture, "The Bear Group," which is part of the attractive landscape in the west courtyard of one of the college hospitals. The question for which few know the answer is "Why the bears?" Sculptured by one of the country's leading artists, Mrs. Archer M. Huntington, it symbolizes the Indian medicine man's reverence for the bear, the strongest animal of this continent, a Beast-God to which he appealed for strength and power in the administration of medicine.

Medicine has come a long way since the early days of Jamestown,

The Bear Group at the Medical College of Virginia, Richmond.
Sculptured by Mrs. Archer W. Huntington

thanks to the Indians, to early colonial physicians and to researchers of more modern times. Its development since the founding of this country at Jamestown in 1607, makes one of the thrilling stories of America. It still has many fields to conquer, so we still need to invoke in our prayer gardens something similar to this Zuni Indian ritual:

> You are my father, bear,
> You are life giving society chief;
> Bringing your medicine,
> You will make your road come hither.

News and Notes

(*Editor's Note: News contributions should be sent to the person whose name appears at the end of the appropriate sections.*)

MESSAGE FROM THE PRESIDENT

The Virginia Academy of Science will hold its annual meeting May 9-11, 1957, at the Hotel Chamberlin at Old Point Comfort, Virginia. It is particularly appropriate that the Academy is meeting in this area during the Jamestown Festival celebration since, as all will remember, it was organized at Williamsburg, Virginia in May 1923. The Academy is also, as a part of its participation in the celebration, preparing an appropriate cover for the James River Monograph, which will be offered for sale during the Festival. A special Jamestown Festival issue of our Journal, which includes material of interest to those visiting Virginia during the Festival, will be offered at a nominal price. The development of science in Virginia, since its initial settlement, is certainly a very important part of the history of our State.

Our host for the meeting, the College of William and Mary including its Norfolk Division, is one of the oldest and most respected institutions in our nation and has contributed significantly to the cultural, educational and scientific achievement of the Commonwealth. Our local Arrangements Committee, made up largely of representatives of this institution, are formulating plans for an excellent meeting and it is now time to consider assembling our meeting's program.

Our section programs are the bulwark of the meeting. They afford the opportunity for Virginia scientists to report on their investigations and research, and the quality of the papers presented, as well as the degree to which the program of a particular section reflects the scientific work carried on in the State, determines to a large extent the caliber and success of our meeting. It has been noted that there has been a falloff in the number of pages in certain sections in recent years. We sincerely hope that each section will be able to arrange a program with a complement of papers sufficient to provide for the full time allotted — one and a half days. Section officers should also encourage all members submitting papers to enter them in competition for the J. Shelton Horsley Award.

In order better to acquaint section officers and committees with the activities of the Academy, a Council meeting was recently held to which all section chairmen and committee chairmen were invited. Almost every activity of the Academy was represented at the meeting. It is our belief that such open council meetings should be held each year

since such a meeting stimulates interest and provides an opportunity for those who, in reality, carry on the work of the Academy to coordinate their activities and exchange ideas. Many suggestions were obtained from the section and committee chairmen which will make for an improved Academy program as well as a fine 1957 meeting.

E. S. HARLOW, PRESIDENT

ROBERT BLACKWELL SMITH, JR., FOURTH PRESIDENT OF THE MEDICAL COLLEGE OF VIRGINIA

The inauguration of Dr. Robert Blackwell Smith, Jr., as the fourth president of the Medical College of Virginia took place on December 17 at 11:00 A.M. in the Monumental Church, Richmond. The Chairman of the Board of Visitors of the College, Buford Scott, presided at the inaugural ceremony.

Following the greeting of the delegates Mr. Scott presented Chancellor William Thomas Sanger who introduced the speaker for the occasion, Dr. Joseph Clarke Robert, President of Hampden-Sydney College whose subject was "The Healing Arts and the American Way."

Dr. Smith was presented to the Honorable Edwin Wren Hudgins, Chief Justice of the Supreme Court of Appeals of Virginia who administered the oath of office. The Reverend Benjamin Rice Lacy, Jr., Chaplain of Hampden-Sydney College gave the prayer of intercession and dedication.

Following the inaugural exercises, a luncheon for delegates and their wives was held in the Social Center of the College, and a reception followed in the headquarters of the Alumni Association.

MINUTES OF THE VIRGINIA ACADEMY OF SCIENCE COUNCIL MEETING – CHARLOTTESVILLE, VIRGINIA – OCTOBER 7, 1956

The Council of the Virginia Academy of Science met in the Committee Room of the Colonnade Club at the University of Virginia. The meeting was called to order by President Harlow at 1:50 P.M.

The following council members were present:

Edward S. Harlow, William G. Guy, Foley F. Smith, Allan T. Gwathmey, Lynn D. Abbott, Jr., B. F. D. Runk, Charles F. Lane, William B. Wartman, Jr., Irving G. Foster, Horton H. Hobbs, Jr., Sidney S. Negus, William M. Hinton, John C. Forbes, Jr., Robert T. Brumfield.

The chairmen of the committees not represented on the council and the section chairmen were invited to attend the meeting. Those present were:

A. B. Massey, Chairman, Virginia Flora Committee; E. D. Crittenden, Chairman, Education Committee; Samuella Crim, Chairman, Science Teachers Section; Leslie E. Edwards, Chairman, Medical Science Section; Mrs. Geraldine M. Duncan, Co-chairman, Membership Committee; W. R. Smithey, Jr., Chairman, Membership Committee; Boyd Harshbarger, Chairman, Place of Meeting Committee; Marcellus H. Stow, Chairman, James River Project Committee and Jamestown Festival Committee; Jack D. Burke, Chairman, Biology Section; Mary E. Kapp, Chairman, Chemistry Section; Frank W. Finger, Chairman, Psychology Section; David M. Crim, Chairman, Engineering Section; Troy J. Laswell, Chairman, Geology Section; Paul M. Reaves, Chairman, Agricultural Sciences Section; A. L. Rosensweig, Chairman, Bacteriology Section; George W. Jeffers, Member, Long-Range Planning Committee; W. Schuyler Miller, Chairman, Virginia Science Talent Search Committee; Henry Leidheiser, Jr., Secretary, Long-Range Planning Committee; Ladley Husted, Member, Long-Range Planning Committee.

President Harlow welcomed the visiting committee and section chairmen and invited them to participate in the deliberations.

Due to the tardiness of several members who had attended an earlier scheduled Long-Range Planning Committee meeting, the discussion began with the activities of the sections.

Activities of the Sections at the 1957 *Meeting.* — President Harlow expressed a desire that all section officers make an effort to have an outstanding program at the 1957 meeting since this was to be held during the Jamestown Festival. He asked the section chairmen present to tell the members of any special activities planned.

Dr. Laswell, of the Geology Section, told of tentative plans for a field trip for Saturday, May 11. Dr. Rosensweig, of the Bacteriology Section, is attempting to arrange for several awards to be given, by that section, to the outstanding micro-biological exhibitors of the Junior Academy. He also hopes to procure publicity, both newspaper and radio, whereby the public may be better informed of the role of microbiology in their daily living. Dr. Reaves, of the Agricultural Science Section, told of plans to recruit new members for his section from people in related fields, especially those in vocational programs.

Mr. Harlow commended those who told of their plans, and expressed the hope that other sections would consider the idea of special awards for Junior Academy exhibitors.

The President asked the chairman of sections having Constitutions, not already approved by Council, to forward them to him so that they could be submitted to Council for approval.

Mrs. Duncan, of the Medical Sciences Section, asked whether it was

permissible to schedule a Saturday morning program at the annual meeting. She was informed that some of the other sections have been doing this for some time and that it was not only permissible, but encouraged, should the section desire to do so.

The secretary told of rosters of section members and addressed envelopes which are available on request to him. He also explained that bills for postage should be submitted to him.

The minutes of the previous meeting were read upon the arrival of those members of the Council who had been delayed due to attending the Long-Range Planning Committee meeting. No corrections or additions were made. The following items were discussed:

The Possibility and Desirability of Acquiring Seashore State Park by the Academy. — This matter was referred to the Long-Range Planning Committee at the May 12 Council meeting. The report of this committee, given by Dr. Abbott, recommended that the Academy itself not attempt to acquire the park, but that the Academy forward to the Governor and to the Directors of Conservation and Development and to the Board of Commissioners of Conservation and Development a recommendation, prepared by the Committee, that Seashore State Park be permanently maintained as a wilderness area. It was further recommended that the area be used for the training of science teachers and a location for appropriate advanced studies in science. The report of the Long-Range Planning Committee was approved by the Council.

After considerable discussion it was the feeling of the Council that, in order to make the recommendation as forcible as possible, it was advisable to consult with the Virginia Advisory Legislative Council Subcommittee and other appropriate agencies before submitting such a recommendation to the Governor and others named above. Accordingly, a motion was passed that the President appoint a committee to consult with appropriate agencies and rephrase, wherever advisable, the recommendation, as submitted by the Long-Range Planning Committee. After preparation by the committee, the President, at his discretion, is to submit the document to the Governor and others named above.

This committee is to consist of the following:

Henry Leidheiser, Jr., *Chairman;* Sidney S. Negus, William G. Guy, Ladley Husted, Marcellus H. Stow, Bruce D. Reynolds, J. T. Baldwin, Jr.

A Survey of the Results of the Virginia Science Talent Search. — The report of the Long-Range Planning Committee also included a proposal to be submitted by the Academy to the National Science Foundation for funds to finance a survey of the results of the Virginia Science Talent Searches. This was prepared by Mrs. B. G. Heatwole,

as decided by Council, at the May 12 meeting. The funds required are $4,500 and the estimated time for the survey is one year. A motion was passed that the President forward this request to the National Science Foundation. It was suggested that he inquire into the possibility of procuring additional funds should the survey extend beyond the one year period.

Reports of Officers and Committees. — FLORA COMMITTEE — Dr. Massey reported the continuing efforts of this committee in classifying the flora of the state. He also reported there was an unpublished paper available on the Flora of Seashore State Park which he would furnish upon request.

VIRGINIA SCIENCE TALENT SEARCH COMMITTEE — Dr. Miller reported that the activities of this committee this year would follow the procedure as practiced in recent years. However, he felt that the survey proposed by the Long-Range Planning Committee would be very valuable to the Science Talent Search Committee.

MEMBERSHIP COMMITTEE — Dr. Smithey and Mrs. Duncan reported that this committee was making a concerted effort to procure additional business members as well as other classes of members.

PLACE OF MEETING COMMITTEE — Dr. Harshbarger reported that he could arrange for the 1958 meeting to be held at the Hotel Roanoke on May 7, 8, 9 and 10, provided Council would approve this action. He stressed the necessity of making hotel arrangements two years in advance, due to extensive advance scheduling of other conferences. It was moved and passed that Dr. Harshbarger be requested to schedule the 1958 annual meeting on May 7, 8, 9, and 10 at the Hotel Roanoke, Roanoke, Virginia.

JAMES RIVER PROJECT AND JAMESTOWN FESTIVAL COMMITTEES — Dr. Stow reported that he has arranged for an appropriate Jamestown Festival cover for the James River Monograph, which will be offered for sale at the Festival. Dr. Hobbs is planning a special issue of the Journal for this occasion.

SCHOLARSHIP COMMITTEE — Dr. Negus told of the plans of this committee in aiding science students to secure academic scholarships.

TRUSTEES COMMITTEE — In the absence of Senator Byrd, the trustees' report was given by the assistant secretary.

VIRGINIA JOURNAL OF SCIENCE — Dr. Hobbs reported that the delay in mailing the July issue of the Journal was due to the printer moving his plant to another site. He expected the July issue and The Proceedings for 1955-56 to be out at an early date.

The Journal officers were authorized by Council to negotiate a new printing contract based upon the best bid submitted.

RESEARCH COMMITTEE — Dr. Forbes stated that the Research Committee had made these research grants totaling $485 and commented on the disposition of funds by the Research Committee.

EDUCATION COMMITTEE — Dr. Crittenden announced that Frank D. Kizer has been appointed assistant supervisor of secondary education and with his background in science this is tantamount to the state having a science supervisor. Much good should result from this appointment.

Scheduling of the Academic Conference at the Annual Meeting. — Dr. Gwathmey indicated that Mrs. Heatwole planned to schedule the main Junior Academy meeting so as not to conflict with the Academy Conference on Thursday evening. It was the feeling of Council that this would result in a more active participation in the conference by the membership. Attempts at holding these two meetings concurrently have resulted in a dwindling of interest in this important phase of the Academy meeting.

Secretarial Assistance for Academy Activities. — All activities of the Academy requiring secretarial assistance should submit requests for funds for this purpose to the Secretary-Treasurer.

Participation of the Academy in Science Fairs. — It was the feeling of Council that it is unwise for the Junior Academy to become a sponsor or participate in Science Fair workshops at the present time.

There being no further business, the meeting was adjourned at 3:55 P. M.

Foley F. Smith, Secretary

REPORT OF THE COMMITTEE ON THE VIRGINIA SCIENCE TALENT SEARCH, 1955-56

The Eleventh Virginia Science Talent Search was conducted in the year 1955-56 in the same general manner as in previous years. The search was made in cooperation with the National Science Talent Search as conducted by Science Clubs of America, Washington, D. C., for the Westinghouse Foundation.

Participation in the search in terms of number of students and the number of schools represented increase nearly twenty-five per cent over the previous year. From those who completed their entry in the search forty-five were chosen to attend the academy meeting in Richmond. Forty-one attended and came with part of their travel expenses paid.

The committee members and invited judges interviewed these finalists and selected fifteen winners and awarded honorable mention to the remainder. Each finalist was interviewed by three judges, and each judge held a fifteen minute interview with each of about ten finalists.

The names of the winners and other finalists were sent to the thirty-four colleges in Virginia that cooperate with the search by listing scholarship aid available to the finalists upon application.

COMMITTEE MEMBERS

James W. Cole
Mrs. Walter Gladding
R. C. Howard
J. H. Johnson
Alfred L. Wingo
Edward E. Dyer
Thelma C. Heatwole
L. W. Jarman
Percy H. Warren
H. H. Garretson, *Chairman*

JUDGES

Florence S. Hague
Paul Osborne
Frank C. Vilbrandt
James B. Newman
O. L. Updike, Jr.

WINNERS AND HONORABLE MENTION

Eric G. Adelberger, Arlington
Frederick F. Andrews, Richmond
Lee Martin Avie, Newport News
William Henry Blake, Arlington
Ardelis Ella Brown, Norfolk
Charles C. Bundy, Lebanon
Tobias W. T. Burnett, Middletown
Nicholas J. Carrere, Arlington
John Clifton Carson, Richmond
Barry Michael Casper, Arlington
Thomas M. Chilton, Portsmouth
Reuben Clay, Richmond
George Willett Cornell, Suffolk
James Donald Curling, Hickory
Victor Maceo Dandridge, Roanoke
Thomas Watson Dougherty, Alexandria
William Charles Doughty, Willis Wharf
Emmett Charles Dye, Jr., Arlington
Leland M. Edmunds, Newport News
Edwin Foster Ford, Arlington
David Earl Foster, Lexington

Edward Harris Friedman, Danville
William G. C. Gordon, Charlottesville
David Warren Hadley, Emporia
Edward Bledsoe Harris, Jr., Richmond
John R. Harvey, Portsmouth
Christofer Henderson, Richmond
Ernest Hibble, Jr., Portsmouth
Philip Frank Ingersoll, Richmond
Clifford T. Ireland, Arlington
Henry Stuart Jacobs, Portsmouth
Al Ray Manson, Martinsville
Maynard Wayne McNeil, Check
James R. Merikangas, Fort Belvoir
William Lee Painter, Richmond
Frank Overton Perkins, Charlottesville
Samuel Graves Snow, Hickory
Robert Lee Tomlin, Jr., Charlottesville
Robert Needy Whitesel, Waynesboro
Ralph Theodore Wirt, Pulaski

The Chairman wishes to thank those who assisted the committee and helped in the interviewing and judging. He would like to thank in particular those faculty members of the University of Virginia and Lynchburg College who assisted in the grading of the student essays.

HAROLD H. GARRETSON, CHAIRMAN

AGRICULTURAL SCIENCE SECTION

Recent staff changes in Animal Husbandry are: Associate Professor J. P. Fontenot, Ph.D., Oklahoma A & M College, replaces W. S. Wilkinson who has gone to Louisiana. Associate Professor J. W. Gossett, Ph.D., Texas A & M, replaces Bryan Baker, Jr., who went to Mississippi. Instructor Owen Thomas, III, 1955 Graduate of Animal Husbandry, replaces Professor R. E. Hunt, who retired on September 1. Instructor A. N. Huff, 1955 Graduate of Animal Husbandry, replaces Hugh E. Henderson who is on leave to study.

Dr. G. C. Graf and Professor Paul Reaves attended the College Feed Conference Board meeting in Lexington, Kentucky, in August. Dr. Graf was elected chairman and Professor Reaves re-elected secretary of the College Section.

Dr. Ellmore and Professor Griffith attended a regional conference in New York recently where the new Weigh-a-day Month Program was discussed.

Dr. Vernon L. Baldwin of the Dairy Science staff, V.P.I., attended the annual meeting of the National Artificial Breeding Association, held in St. Paul Minnesota, in September.

The V.P.I. Dairy Cattle Judging Team and the Virginia 4-H Dairy Cattle Judging Team participated in regional and national contests in September and October. Professor R. A. Sandy was coach of the college team and Professor William N. Patterson was coach of the 4-H team.

The Department of Dairy Science conducted a Dairy Cattle Judging Conference on campus in July. This conference was sponsored by the Virginia State Dairymen's Association.

Dr. N. R. Thompson attended the Biometrics meetings in Detroit in September.

Dr. M. Daniel Lane, B. S., and M. S. Iowa State College, Ph.D. University of Illinois, joined the staff on the Biochemistry and Nutrition Department in August, 1956. Dr. Lane will pursue studies concerning the extra-visual function of Vitamin A in animals and will also be responsible for some graduate teaching.

The following entomologists attended the meetings of the Eastern Branch of the Entomological Society of America in November in Atlantic City: Dr. C. H. Hill, Mr. A. M. Woodside, Mr. C. B. Dominick, Dr. M. L. Bobb, Dr. E. C. Turner, Jr., and Dr. J. M. Grayson. Several papers were presented by members of the group.

Dr. E. M. Raffensperger, Mr. J. G. Barker, Dr. F. E. Jarvis, and Dr. J. M. Grayson attended the National Meetings of the Entomological Society of America in December in New York City, with two papers being presented.

Mr. Arthur L. Eiser, Jr., resigned as Instructor of Horticulture at V. P. I. effective September 1, 1956, to continue study for a Ph.D. degree in Botany.

Mr. Robert W. Gray, II has been appointed Instructor of Horticulture at V.P.I. effective September 1, 1956. Mr. Gray will assist with the teaching and research work in floriculture and nursery management.

Dr. H. A. Rollins, Jr. was transferred from the Winchester Fruit Research Laboratory to V.P.I. at Blacksburg as of July 1, 1956, to serve as project leader of the fruit extension program. Dr. Rollins is filling the vacancy left at the result of the retirement of Professor A. H. Teske, April 30, 1956.

At the meeting of the Technical Committee of the Southern Regional Poultry Breeding Project in Athens, Georgia, on October 8-9, 1956, Dr.

James H. Bywaters of the Department of Poultry Husbandry at V.P.I. was elected to the Executive Committee for a one year term.

R. H. Burtner started work as a Specialist with the Poultry Department in September of this year, with primary emphasis on junior poultry activities. Mr. Burtner was graduated from V. P. I. in 1940. Most of his experience since then has been in county agent work.

Dr. Jesse Lunin of the Soil and Plant Relationship Branch, Agricultural Research Service, U.S.D.A., established headquarters at the Virginia Truck Experiment Station, Norfolk, on September 4, 1956. Dr. Lunin will serve as coordinator between the research program at the Truck Station dealing with salinity problems in irrigation for the middle Atlantic region and the research program on related problems at the U.S.D.A. Salinity Laboratory, Riverside, California. Research on the utilization of brackish water is being conducted at the Truck Station by Mr. M. H. Gallatin of the Eastern Soil and Water Management Branch, ARS, U.S.D.A., who began the program in May 1955. Dr. Lunin received his undergraduate training at Oklahoma A & M College and received his Ph.D. degree from Cornell in 1949. Immediately before coming to Norfolk he was stationed in the Dominican Republic with the Research Station of the West Indies Sugar Corporation.

Dr. Edward A. Borchers joined the research staff of the Virginia Truck Experiment Station, Norfolk, on November 5, 1956, in the position of Plant Breeder to replace Dr. Forman T. McLean, retiring. Dr. Borchers was born in New York state and received his undergraduate training at Cornell and received his M.S. degree in 1953 from N. C. State College. His Ph.D. was received from the University of California in 1956.

Paul W. Stoneburner of Waynesboro, Virginia was elected to succeed E. T. Swink, Blacksburg, Virginia, as President of the Virginia Section, American Society of Agricultural Engineers at the annual meeting of the section held in Richmond on October 20. Also elected, to serve as Vice-Presidents for 1956-57 were J. Nick Jones, Jr., Cecil Wheary, Blacksburg, Virginia, and George Duke, Holland, Virginia. A. J. Lambert, Blacksburg, Virginia, was re-elected Secretary-Treasurer.

Dr. Ralph G. Kline joined the staff of the Virginia Agricultural Experiment Station as Associate Agricultural Economist in July. Dr. Kline is a native of Pennsylvania. He received his Ph.D. from N. C. State in 1956. He will work primarily in the field of farm management research.

Dr. R. E. Blaser, Agronomy Department, V.P.I., spent five months

in New Zealand and Australia as the guest of those countries advising on forage crops.

Dr. S. S. Obenshain, of the Agronomy Department, V.P.I., served as head of a fertilizer consultant team in Korea for about six weeks and brought back many interesting tales both of agriculture in Korea and otherwise.

Dr. C. I. Rich and Dr. Kroontje returned the early part of October after having attended the International Soil Science Society Meeting in Paris, where Dr. Rich presented a paper entitled "The Distribution of Free Iron Oxides in Four Coastal Plain Soils in Virginia." Prior to the meeting, Dr. Kroontje was visiting his family in his native Holland. Dr. Rich visited the Rothamstead Experiment Station and the Macauley Institute in England and Scotland before attending the meeting. After the meeting, both Dr. Rich and Dr. Kroontje visited two experiment stations in conjunction with the University of Bonn, in Germany, and also the soil testing laboratory at Oosterbeek and the Waganingen Agricultural Experiment Station in Holland.

Dr. C. I. Rich, Agronomy Department, V.P.I., has just been asked to serve as Consulting Editor of Soil Science. This periodical, published by Rutgers University, has international circulation and being selected as Consulting Editor is recognition of world standing in his particular field. Dr. Rich has also been recognized by the Soil Science Society of America, in his being assigned to serve on their committee on clay mineral studies. — CARL W. ALLEN, *Virginia Polytechnic Institute.*

ASTRONOMY, MATHEMATICS, AND PHYSICS SECTION

Additions to the Physics Staff at V.P.I. for the present year are Dr. Leon S. August, who completed graduate work at L.S.U. recently, David L. Bushnell, formerly on the staff of Iowa University, Harry L. Reaves who has served at ORNL, and Jean S. Ryan formerly at the University of Kentucky and the Emory Tumor Clinic.

Dr. Andrew Robeson, Asst. Prof. of Physics at V. P. I. is on leave to attend the Oak Ridge School of Reactor Technology.

Dr. J. Gordon Stripe, Jr., Prof. of Physics at R.M.W.C. is on sabbatical leave. He holds a Carnegie Internship at Harvard University where he is teaching and working in solid state physics. Mr. George Whitehead, formerly at William and Mary has been appointed Asst. Prof. of Physics at R.M.W.C. Mr. Whitehead holds degrees from Cambridge University.

Jackson J. Taylor has recently been promoted to Associate Prof. of Physics at the University of Richmond, where he heads the Department

of Physics. On the staff are Drs. Addison Campbell and Billy Sloope. Dr. Sloope is visiting professor at Randolph-Macon this year.

The following items of interest came from the Dept. of Physics at the University of Virginia. Dr. Stephan Berko has been appointed a Sloan Foundation Fellow for the coming year, and Prof. E. C. Stevenson will carry on research at Charlottesville as a Senior Postdoctoral Fellow of the N.S.F. He will work in radioastronomy. Dr. Dexter Whitehead, a graduate of the University and formerly at N. C. State has been appointed Asst. Prof. of Physics.

Dr. Robert C. Yates is now Chairman of the Mathematics Department at William and Mary. Mr. L. C. Leonard has joined the William and Mary faculty as lecturer in mathematics for the present year.

Asst. Prof. V. Ray Hancock of the Mathematics Department at V.P.I. is on leave doing graduate work at Tulane University. Three men have been added to the staff of the Mathematics Dept. as Asst. Professors. They are Dr. Svend T. Gormsen, Capt. E. W. Lammons, and Mr. Robert H. Riffenburgh.

The completion of a ten year project involving the search for red dwarfs over a large area of the northern sky has been announced by McCormick Observatory. The work was done under the direction of Prof. Vyssotsky, aided by Prof. E. C. Dyer and others of the staff.

In its annual report, the Observatory announced the completion of the distance determination of 2000 stars. No other Observatory has yet reached this number.

After two years at McCormick as an OEEC fellow, Dr. H. K. Eichhorn has returned to the Vienna Observatory. Mr. A. G. Balz, Jr., formerly at McCormick, has been appointed an assistant at the Lick Observatory.

Of interest to physics is an announcement that the University of Virginia has been given a 75 MEV electron synchrotron.

The V.P.I. natural uranium graphite exponential reactor has now been completed. This facility, along with the 2 MEV Nuclear Accelerator and the Nuclear Reactor Simulator is to be used in the graduate program in Nuclear Engineering. — I. G. FOSTER, *Virginia Military Institute.*

BACTERIOLOGY SECTION

At the fall meeting of the Virginia Branch, Society of American Bacteriologists, the members voted to establish an annual award of $25.00 payable from Branch funds, and a certificate of merit to the

person presenting the best paper or project in microbiology at the annual meeting of the Junior Academy of Science, held in conjunction with the Virginia Academy of Science. The purpose of the award is to stimulate interest and encourage research by future scientists in the various fields of microbiology. Final establishment of the award is contingent upon the approval of the Virginia Academy of Science.

Mrs. B. H. Caminita attended the International Congress of Developmental Biology and the International Symposium on Cytodifferentiation in Providence, R. I., July 23-31, 1956; and a work conference on immunology and development at Bar Harbor, Maine, August 7-9, 1956. — P. ARNE HANSEN, *University of Maryland.*

BIOLOGY SECTION

Mr. Bruce D. Reynolds has retired as Director of the Mountain Lake Biological Station and Horton H. Hobbs, Jr., has been appointed as his successor.

Mr. Warwick R. West, University of Richmond, was promoted from Assistant Professor to Associate Professor of Biology beginning September 1, 1956.

Mr. J. D. Burke and Mr. W. S. Woolcott, University of Richmond, are working on a problem dealing with the oxygen capacity of fishes. The Virginia Academy is supporting this work through a research grant to cover travel expenses on their collecting trips.

Mr. Nolan E. Rice, University of Richmond, is studying the freshwater jellyfish in Virginia and getting some interesting results.

Construction of a new research vessel for the Virginia Fisheries Laboratory is well under way at Curtis-Dunn Marine Industries, Inc., West Norfolk. The scheduled completion date is November 30, 1956.

Preliminary plans for a new laboratory building were approved by the Board of Administration of the Virginia Fisheries Laboratory at a recent meeting. To be about equal in size to the present building, the new laboratory will provide much-needed space for permanent staff, graduate students, and summer workers. In addition to office and laboratory space, there will be several dormitory rooms, a dining-room, kitchen, and lounge.

Mr. Jay D. Andrews, of the Virginia Fisheries Laboratory staff, is President of the Atlantic Estuarine Research Society this year, and Mr. Dexter Haven is a member of the Executive Committee. Mr. Andrews also was recently appointed to a three-year term on the Editorial Board of the National Shell-fisheries Association.

Mr. James J. Murray, Jr., has been appointed instructor in the Department of Biology at Washington and Lee University. Mr. Murray graduated from Davidson College in 1951, was a Rhodes Scholar, receiving the B. A. degree in 1954 and the M. A. degree in 1956 from Oxford. Mr. Murray has also taken part in scientific expeditions in the high Himalayas.

Two new isolation buildings for research in diseases of poultry will be constructed this fall for the use of the Animal Pathology Section of the Biology Department at V.P.I. Bids were let on October 24, 1956.

Mr. A. B. Massey was promoted to Professor of Biology on September 1, 1956. Mr. Massey has been associated with V.P.I. as a teacher and research worker for 28 years. Since 1935, he has served as Botanist for the Wildlife Unit.

Mr. Perry C. Holt has joined the staff of the Biology Department at V.P.I. as Assistant Professor of Zoology. Mr. Holt received his Ph.D. from the University of Virginia and comes to V.P.I. from East Tennessee State College. He replaces Mr. Frank R. Burleson who resigned.

Mr. William G. Evans has joined the staff of the Virginia Agricultural Experiment Station as an Assistant Professor of Entomology. Mr. Evans, who received his Ph.D. degree from Cornell University, replaces Mr. A. A. Muka who resigned to accept an Assistant Professorship at Cornell.

Mr. and Mrs. J. M. Grayson are the proud parents of their fourth girl, Mary Ellen, born June 29. Mr. Grayson is head of the Entomology section of the Biology Department of V. P. I.

Mr. and Mrs. E. C. Turner, Jr., are the parents of a boy, Edgar Craig, born September 1, 1956. Mr. Turner is Associate Entomologist with the Virginia Agricultural Experiment Station.

Mr. and Mrs. J. O. Rowell are the parents of a boy, Robert Shelley, born September 7, 1956. This is the third son and fifth child for the Rowells. Mr. Rowell is an Entomologist with the Agricultural Extension Service. — ROBERT T. BRUMFIELD, *Longwood College.*

CHEMISTRY SECTION

Dr. John H. Yoe, Professor of Chemistry and Chairman of the Department of Chemistry of the University of Virginia, has received one of the nation's top scientific honors in being named as the recipient of the Fisher Award in analytical chemistry for 1957. Dr. Yoe was honored for his "pioneering work in colorimetric analysis and organic analytical reagents." His achievements in the field of analytical chemistry also brought him the 1956 Distinguished Service Award, presented by the

Virginia Section of the American Chemical Society. An additional honor is his election as the next chairman of the Division of Analytical Chemistry, A. S. C.

Several staff changes have been announced in the University of Virginia Department of Chemistry: Dr. John S. Belew has resigned to accept a position at Baylor University, and Dr. Paul N. Schatz has been appointed Assistant Professor of Chemistry, Dr. Oscar R. Rodig as Acting Assistant Professor. Dr. Schatz received his doctorate from Brown University and held a year's postdoctoral fellowship with Professor Linus Pauling at the California Institute of Technology before joining the Virginia staff. Dr. Rodig received his Ph.D. from the University of Wisconsin and has had two years of postdoctoral work, one with Professor E. R. H. Jones at the University of Manchester in England and the other with Professor V. Prelog of the Federal Institute of Technology at Zurich, Switzerland.

Dr. Thurman T. Grossnickle has been appointed Assistant Professor of Chemistry at Bridgewater College. Dr. Grossnickle received his doctorate in organic chemistry in 1955 from Wayne University, and has been awarded a Research Corporation grant for the study of the mechanism of the dienonephenol rearrangement. Dr. Lowell V. Heisey, Professor of Chemistry at Bridgewater, is working on a joint project with the Department of Botany of the University of North Carolina under an American Chemical Society grant for the synthesis and testing of hydrazide plant hormones.

Dr. J. B. Sanders has been added to the chemistry staff at Hampden-Sydney College. Dr. Sanders performed his graduate work at the University of Iowa (M. S.) and at the University of North Carolina (Ph.D.) and was formerly associated with the National Bureau of Standards. C. W. Bondurant, formerly on the Hampden-Sydney staff, has joined the faculty of Roanoke College.

Dr. Stanley E. Kerr, Professor of Biochemistry at the American University of Beirut, is spending a sabbatical year in the United States as the A. D. Williams Visiting Professor in the Department of Biochemistry at the Medical College of Virginia. Dr. Edwin S. Higgins has also joined the biochemistry staff at MCV as an Assistant Professor. He was awarded his Ph.D. degree by the State University of New York Medical School at Syracuse last June.

The inauguration of Dr. Robert Blackwell Smith, Jr., as the fourth president of the Medical College of Virginia, took place on December 17 in the Monumental Church, Richmond. Included among the distinguished speakers for the occasion were Dr. Colgate W. Darden, President of the University of Virginia and Governor Thomas B. Stanley. The

principal speaker was Dr. Joseph Clark Robert, President of Hampden-Sydney College. The Medical College of Virginia was established in 1837 as the Medical Department of Hampden-Sydney College, was incorporated in 1854, and became a state institution in 1860. In 1913 it was consolidated with the University College of Medicine, founded in 1893 by Dr. Hunter Holmes McGuire.

Dr. J. S. Pierce, Professor of Organic Chemistry at the University of Richmond, has been granted a sabbatical leave. During his absence, his teaching duties will be taken over by Drs. Robert S. Murphey and Carl D. Lunsford, both of the A. H. Robins Company, Richmond, and by Charles Varsel of Philip Morris and Co., Ltd., Inc. Both industrial concerns were most cooperative in granting time to their staff members to handle these extra duties during their regular working day.

Dr. Pierce, assisted by Y. H. Chen, J. A. Richman, and V. F. Garman, also worked full time during the summer on a project financed by the Geschickter Fund for Medical Research, Inc. The work is being continued on a part-time basis during the fall. Another project under Dr. Pierce's direction is concerned with the "Synthesis of Compounds to be Used in the Study of Cancer Cell Metabolism." Mr. L. D. Hancock is assisting with this work, which is financed by a grant from the National Cancer Institute.

Dr. William Allan Powell has been promoted to an Associate Professor of Chemistry at the University of Richmond. The Puryear Fellowship, awarded annually to a promising graduate student in the Department of Chemistry, was received this year by G. Christian Guvernator. Recent graduates of the University of Richmond who were awarded M. S. degrees include: Andrew G. Richardson, Ying-Ho Chen, James W. Cook, and William P. Moore. Mr. Richardson and Mr. Moore completed their graduate work by taking advantage of the night school program.

Dr. Carl Hoback, Ph.D., University of West Virginia, and Charles Oestreich, M. S., Ohio State University, have been added to the chemistry staff at the Virginia Military Institute. C. W. Smart, also on the V.M.I. staff, has been elected secretary of the Blue Ridge Section of the American Chemical Society. Plans for a new V. M. I. chemistry lecture room with a seating capacity of 250 have been completed and will be let out on bid this year.

Two staff changes have been announced on the chemistry faculty at Virginia Polytechnic Institute. Dr. Ralph G. Steinhardt has resigned to accept the chairmanship of the Chemistry Department of Hollins College, and he has been replaced by Dr. Samuel M. Graham, who served last year on the faculty at Hampden-Sydney College. Dr. Graham is a graduate of V.P.I. (B. S. and M. S.) and received his doctorate from

Catholic University. In addition to his teaching experience at Hampden-Sydney, he has served on the staffs at V.P.I. and at Catholic University, and has had industrial experience with the du Pont Company.

The Office of Ordnance Research, U. S. Army, has renewed two contracts at V.P.I., one under Dr. F. A. Vingiello on the "Synthesis of Hydrocarbons," said the other under Dr. P. C. Scherer on "Dielectric Properties of Solutions of High Polymers." Dr. D. W. Levi's research contract with the Research Corporation on "Solution of Some High Polymers" has also been renewed.

Two recent papers from the V.P.I. Chemistry Department were "The Use of Alumina in Aromatic Cyclodehydration" by F. A. Vingiello and A. B. Borkovec, which appeared in a recent issue of the *Journal of the American Chemical Society*, and "Distribution Curves ond Mechanical Properties of Polymers," by P. C. Scherer, Monograph University Microfilms Publications, No. 16 (1956). Dr. R. C. Krug presented a paper, with Dr. Teh Fu Yen, at the September Meeting of the American Chemical Society in Atlantic City on "Unsaturated Cyclic Sulfones." Dr. Yen received his Ph.D. degree from V.P.I. last June and is now associated with the Goodyear Tire and Rubber Company in Akron, Ohio. Dr. F. A. Vingiello and Dr. J. W. Watson, Chairman of the V.P.I. Department of Chemistry, also attended the Atlantic City Meeting. Dr. Watson is Councilor of the Virginia Blue Ridge Section and is a member of one of the Standing Committees of the Council. Dr. John W. Murray attended and presided over the forum of Mineralogy and Geology at the Annual Convention of the National Speleological Society held at Natural Bridge in April. He presented a paper entitled "Some Phosphate Minerals from Bat Guano."

Dr. E. S. Gilreath, Head of the Chemistry Department at Washington and Lee University, has completed a manuscript for a textbook in advanced inorganic chemistry, which is designed for advanced undergraduate study. It will be published by McGraw-Hill. Dr. J. H. Wise, also on the W. & L. staff, has recently published a manual for freshman chemistry. In addition to his writing, Dr. Wise worked for the third consecutive summer at the Oak Ridge National Laboratory in the Stable Isotope Division. Dr. James K. Shillington is continuing his research project, sponsored by the National Science Foundation, on the resolution of optically active ketones. Dr. W. J. Watt served during the summer as a research associate on an inorganic polymer project at Cornell University. Dr. Watt received his doctor's degree from Cornell last February.

On the industrial front, several additions to the research staff at the American Tobacco Company, Richmond, have been announced: Graham S. Palmer, Dr. E. C. Cogbill, and Dr. Stanley J. Clark. Mr. Palmer

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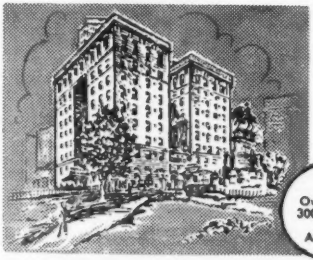

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is a recent graduate of the College of William and Mary. Dr. Cogbill is a graduate of the University of Virginia and served on the Virginia faculty for a number of years. Later he was affiliated with Duke University as Research Associate, Department of Chemistry, Tobacco Research Project. Dr. Clark is a graduate of the University of Birmingham, England, and prior to coming to Richmond was associated with the Louisiana State University as a Research Fellow in the Department of Chemistry. He is a native of Tipton, Staffordshire, England.

From Experiment, Inc., Richmond, Dr. H. F. Calcote, Manager, Research Division, has resigned to accept a position as president of the Princeton Radiation Chemistry Laboratory, Inc. in Princeton, New Jersey. Gerald Golub also resigned and is now with the Air Products Company in Allentown, Pennsylvania. Among the recent additions to the staff: Dr. Welby G. Courtney, Senior Scientist, from the Freeport Sulfur Company in Braithwaite, Louisiana; Willard E. Meador, Jr., who has been serving as a part-time Instructor in Physics at the University of North Carolina, and who will receive his doctorate from U.N.C. shortly; Dr. U. V. Henderson, Senior Scientist, from the Office of Naval Research in Washington; Dr. Frank R. Groves, Senior Scientist, from the Atlantic Refining Company in Dallas, Texas; also Stanley R. Jones, Associate Scientist, who received recently his M. S. degree in Physics from the University of Delaware, and Joseph A. Oddo, Junior Scientist, formerly with E. I. du Pont, and Froehling and Robertson, Richmond.

Dr. H. F. Calcote attended the fall meeting of the American Rocket Society in Buffalo, New York in September and presented a paper on the "Correlation of Ramjet Fuel Performance with Combustion Parameters." He also served as vice-chairman of the Propellants Session at the meeting. Dr. Lloyd E. Line attended the Joint ANAF Second Symposium on Solid Propellant Ignition held in Kansas City in October. Dr. Calcote, Dr. Line, and Dr. William E. Rice attended the Sixth International Symposium on Combustion in New Haven, Conn., in August. Dr. Calcote was chairman of the session on Structure and Propagation of Laminar Flames. Dr. Line presented a paper, with W. J. Clark and J. C. Rahman, entitled "An Apparatus for the Study of Dust Explosions." Dr. H. F. Calcote and Dr. William E. Rice will attend the Ninth Annual Gaseous Electronics Conference held in November at the Westinghouse Research Laboratories in Pittsburgh. Dr. Calcote will present a paper, written with W. E. Rice and I. R. King, entitled "Probe Measurements of Ionization in Flames."

From Virginia-Carolina Chemical Corp., Richmond. Newcomers to the Research and Development Department of V-C are the following: William W. Sadler, fertilizer chemist, a graduate of the University of Richmond and formerly with Philip Morris; Robert C. Parsons, organic

chemist, also a University of Richmond graduate and formerly with the Virginia Department of Highways; Robert C. Parsons, patent Coordinator, from Emory University and Devoe and Reynolds Co.; Ralph Cool, development engineer, from North Carolina State; Miss Suzanne M. Borke, analytical chemist, from Mary Washington College; Andrew R. Jones from the University of Miami, and formerly with Froehling and Robertson; and James L. Carnes, a graduate of the University of Richmond. James M. Carruth, a graduate of V.P.I., has been added to the Technical Service Group.

Edwin C. Cox, V-C Vice-President, presented a paper "Phosphatic Fertilizers-1956-How Far-Where To?" at the September Meeting of The American Chemical Society in Atlantic City. Mr. Cox has also been named to the governing board of the Agricultural Research Institute of the National Academy of Sciences. Herschel Jenkins, Fiber Section Leader, is the author of an invited article "Proteins as Fiber Raw Materials" to be published in the *Encyclopedia of Man-Made Textiles.* M. A. Manzelli, Biological Section Leader, presented a paper in "Recent Development in Nematocides" at the Annual Convention of Southern Feed and Fertilizer Control Officials in June. Portions of the paper were published in the August issue of *Farm Chemicals.*

At the Virginia Institute For Scientific Research, Richmond, Donald F. Koenig has resigned to pursue work towards his doctorate in biophysics at Johns Hopkins University. He has been replaced by Dr. James K. Palmer, formerly with Connecticut Agricultural Experimental Station, New Haven. Other recent additions to the VISR staff include: Dr. Robert A. Lefever, from Linde Air Products, Tonawanda, New York; Dr. James F. Kirn, from Swift and Company, Chicago; and Dr. Karl Killer, from the Swiss Federal Institute of Technology. Dr. Palmer is a graduate of Penn State in biochemistry. Dr. Lefever received his degree in inorganic chemistry from Massachusetts Institute of Technology, and Dr. Kirn is a graduate of Michigan State University in the field of physical chemistry. – CARL J. LIKES, *Virginia Institute For Scientific Research.*

ENGINEERING SECTION

Acting as Virginia Polytechnic Institute's representative to the Oak Ridge Institute of Nuclear Studies, Professor Frank Vilbrandt attended the 10th anniversary celebration of the founding of the organization on October 15 and attended a meeting of the Council the following day. Dr. Vilbrandt was the guest of the West Virginia Pulp and Paper Company on October 18 and 19 on the occasion of the formal opening of this company's new research laboratory. Professor Nelson F. Murphy, research professor of chemical engineering at Virginia Polytechnic Institute, presented a paper on "Electrodeposition of Aluminum from Ether-

Amine-Aluminum Chloride Solutions" to the American Electroplaters' Society in Washington, D. C. June 21, 1956. Professor Fred Bull, head of the Chemical Engineering Department at Virginia Polytechnic Institute has announced the appointment of Mr. David A. Hayford as a new Assistant Professor of Chemical Engineering.

Professor Robert Truitt, Head of the Aeronautical Engineering Department at Virginia Polytechnic Institute, was employed during the past summer as a Senior Engineer at the Glenn L. Martin Company in Baltimore where he was engaged in research in the field of Aerodynamic Heating. He is now writing a manual on "Fundamentals of Aerodynamic Heating" for the Glenn L. Martin Company.

Mr. T. E. Shelburne, Director of the Virginia Council of Highway Investigation and Research, attended the meeting of the Southeastern Association of State Highway officials in Roanoke, Virginia, September 5 to 7 where he presented a paper on "Highway Research." On September 10 Mr. Shelburne went to LaSalle, Illinois to attend a meeting of the National Advisory Committee for the A. S. H. O. Road Test. On October 17 to 19 he attended the national meeting of the American Society of Civil Engineers in order to take part in the District 6 Council meeting.

Dean Lawrence R. Quarles of the University of Virginia School of Engineering attended the annual meeting of the American Society for Engineering Education from June 25 to 29 at Ames, Iowa. On September 5 to 8 he attended the Deans' and Presidents' Conference on Nuclear Energy Education of the Atomic Energy Commission at Gatlinburg, Tennessee. In September Dean Quarles attended the Atomic Industrial Forum and the meeting of the Board of Directors of the American Nuclear Society to which he has recently been elected.

The Engineering School of the University has just completed a training program for the Army Package Power Reactor during which Professors R. E. L. Gildea, O. L. Updike and L. R. Quarles participated as instructors. Professor R. M. Hubbard of the Chemical Engineering Department of the University relinquished his position as Director of the Engineering Experiment Station on September 1 to Professor Orville R. Harris. He served in this capacity since the reactivation of the Experiment Station in August, 1951. Professor Hubbard is now on leave of absence from his academic position but is now engaged in research at the University. In September he visited New York to attend Instrument Exposition and on August 18, 19 was the guest of the West Virginia Pulp and Paper Company on the occasion of the opening of this company's new research building.

Professor Orville R. Harris attended the Institute of Radio Engineers

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Symposium on Solid State Devices on October 20 at Winston-Salem, North Carolina. — ROBERT M. HUBBARD, *University of Virginia.*

GEOLOGY SECTION

Robert S. Young resigned from the Virginia Division of Geology August 15 and is now regional geologist with Roland F. Beers, Inc., Troy, New York. He will be in charge of base metal sulfide exploration in the southeastern U. S. from Georgia to and including Virginia. His office in Charlottesville, Virginia.

Wayne E. Moore has resigned from the V.P.I. Department of Geological Sciences and in January will be with The California Company in Pensacola, Florida.

H. Robert Hopkins joined the Virginia Division of Geology October 1 as junior geologist. He will make detailed magnetometer surveys of magnetite and hematite deposits and of certain selected districts in the Piedmont. During the summer he made a magnetometer survey of the Lynchburg hematite and limonite district.

Robert S. Wood also joined the Virginia Division of Geology October as a part-time junior geologist. He will complete a detailed study of the Chepultepc limestone of the Shenandoah Valley which he began in the summer.

Edwin O. Gooch is continuing his investigation of vermiculite in Virginia. The results will be published by the Virginia Division of Geology early in 1957.

Carl T. Meyertons began a study of the clays and shales of the Danville Triassic area, which will be the subject of his doctor's thesis at V.P.I. The work is a cooperative project of the Virginia Division of Geology and the Virginia Engineering Experiment Station.

W. T. Harnsberger, now at Madison College, and J. G. Patterson investigated during the past summer the geology and mineral resources of the Broadway quadrangle, mostly in Rockingham County, for the Virginia Division of Geology.

"Sulfide Mineralization in the Shenandoah Valley of Virginia" by Paul Herbert, Jr., and Robert S. Young has been issued as Bulletin 70 of the Virginia Division of Geology. "Titanium" by A. A. Pegau is the subject of Circular No. 5 of the Virginia Division of Geology. "Oil and Gas Wells Drilled in Southwestern Virginia 1950" are noted in U. S. Geol. Surv. Bull. 1027-L. "The Mineral Industry of Virginia (1953)" as noted in U. S. Bureau of Mines Minerals Yearbook has been reprinted

as Virginia Division of Geology Reprint Series No. 19. The authors are Norwood B. Melcher and Alvin Kaufman.

Marcellus H. Stow has been appointed geological consultant to the director of the Virginia Department of Conservation and Development. During the summer he worked for Carter Oil Company collecting rock samples for microfossil study. He attended the recent G. S. A. meetings in Minneapolis.

Leonard Harris, U.S.G.S., is mapping the Stickleyville quadrangle in Scott County after completing a report on the adjacent Duffield quadrangle. James Stephens has started a long-range U.S.G.S. project of mapping a diagonal belt of quadrangles starting in Lee County, Virginia adjacent to the Rose Hill district and continuing southeastward across east Tennessee to the Smoky Mountains.

The new field camp station of the V.P.I. Department of Geological Sciences at Saltville has been completed. It will accommodate 24 students and three staff members and was built by the Olin Mathieson Chemical Company. Pre-Shrunk, Inc., donated the cinder block; General Shale Inc., donated the Roman facing brick; and U. S. Gypsum, the plaster board.

The new geochemical laboratory of the V.P.I. Department of Geological Sciences is nearing completion. Equipment now available for such studies includes the latest model G. E. X-ray diffractometer, Beckman model B spectrophotometer with flame attachment, and an electron microscope.

Byron Cooper discussed "Appalachian Dolomites" at the annual meeting of the Appalachian Geological Society held in Charleston, West Virginia, October 26. Cooper, G.S.A. councilor, and Bruce W. Nelson attended the recent G.S.A. meetings in Minneapolis.

R. V. Dietrich and W. D. Lowry and 18 seniors and graduate students in geology at V.P.I. visited October 18-19 the James River Hydrate Co., quarry and plant at Buchanan, the Cold Spring clay deposit, the Crimora manganese mine, the Alberene Stone Company quarry and mill at Schuyler, the "Solite" operation and the Buckingham-Arvonia, LeSueur, and Williams slate quarries, all near Arvonia, Virginia.

R. V. Dietrich is studying ptygmatic folds of the so-called Alexandria batholith near Little Hammond, New York and similar features southeast of Bryson City, North Carolina. This is a G. S. A. sponsored project. Dietrich has also begun a study of the granitic mass near Independence, Virginia. — W. D. LOWRY, *Virginia Polytechnic Institute.*

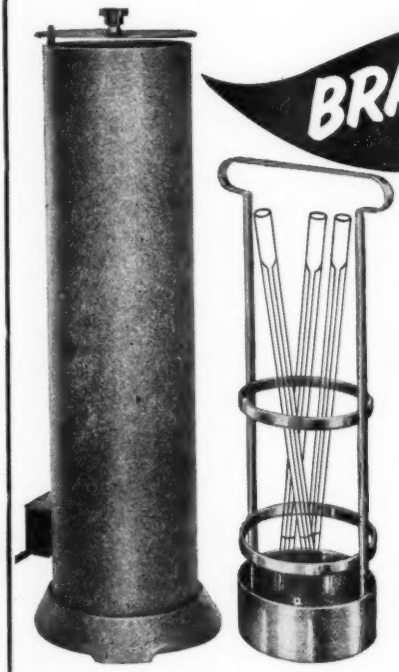
PSYCHOLOGY SECTION

Virginia psychologists were active, as usual, at the 1956 Meetings of the American Psychological Association in Chicago. Dr. Frank A. Geldard of the University of Virginia gave the presidential address before the Division of Experimental Psychology on the subject, "Adventures in Tactile Literacy." Dr. Frank W. Finger, who is president of the Division on the Teaching of Psychology, and Secretary of the Division of General Psychology, spoke on the "Use of Different Curricular Arrangements" at a Symposium on Coping with Increasing Enrollments. Dr. Finger also was the joint author with Dr. L. S. Reid of two papers, "The Role of Reinforcement in General Activity," and "The Effect of Activity Restriction Upon Adjustment to Cyclic Food-Deprivation." Dr. K. E. Lloyd of the University of Virginia presented a paper on "Relearning and Transfer of Training as a Function of Stimulus Similarity and Interpolated Learning." Dr. William M. Hinton of Washington and Lee, and Dr. Arthur Bachrach of the University of Virginia, served as delegates of the Psychology Section to the Workshop on Certification and Licensure, sponsored by the Conference of State Psychological Associations. Dr. Hinton later served on a panel which presented a summary of the Workshop to a general APA audience. Dr. Hinton was the official representative of the Virginia Academy of Science at the Conference of State Psychological Associations. Dr. John K. Bare and Dr. Stanley B. Williams of the College of William and Mary presented a paper on "Radar Operator Efficiency as a Function of Scope Size." Dr. Dell Lebo of the Richmond Professional Institute read a paper on "The So-called Process of Nondirective Play Therapy" at a program sponsored by the Division on Developmental Psychology. Dr. Henry Winthrop of Hollins College read a paper on "The Relation Between Attitude-consistency and Body Type," at a session sponsored by the Division of Personality and Social Psychology.

Dr. John K. Bare is currently doing research at the College of William and Mary on "A Detailed Investigation of Eating Behavior" under sponsorship of the U. S. Public Health Service. Mr. Lee E. Paul has been appointed Assistant Instructor in Psychology at the College of William and Mary.

Dr. William F. Battig, Ph.D., from the University of Wisconsin, has been appointed Assistant Professor of Psychology at the University of Virginia. Dr. Battig came to Virginia from Stanford where he had been engaged in research on problem solving under a National Science Foundation fellowship.

Dr. Philip Himelstein left the V. A. Hospital in Roanoke to join the research staff at Lackland Air Force Base in Texas. Dr. Warren W. Webb has accepted a position at Vanderbilt University. Dr. Hiram



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L. Gordon transferred in August to the V. A. Hospital, Fort Lyon, Colorado. The staff at the V. A. Hospital at Roanoke now includes Drs. Burke M. Smith, B. J. Fitzgerald, Roy A. Eck, William J. Eichman, Earl G. Guyer, Gordon E. Rader, and John J. Mallet. Mr. Richard F. Patterson of Florida State University at Tallahasee, Florida has joined the psychology staff of the Roanoke Guidance Center.

Dr. Jay Chambers assumed the position as Senior Psychologist at Eastern State Hospital in July. Dr. Chambers is a Ph.D. of the University of Kentucky and came to Williamsburg from Muskingum College.

The Virginia Psychological Association, which was organized in May, 1956, scheduled a fall meeting in Richmond on November 16. The program included a panel discussion, "New Responsibilities of State Associations Under Proposed APA and CSPA Organizational Changes," a dinner, and business meeting. There will apparently be considerable overlapping of membership and interests between the newly-created VPA and the Psychology Section of the Academy. As of 1 November 1956, there were approximately 300 psychologists in the State of Virginia who were members of the American Psychological Association; of this number some 70 had joined the Virginia Psychological Association. — RICHARD H. HENNEMAN, *University of Virginia.*

STATISTICS SECTION

The following were awarded Ph.D. degrees in statistics from the Virginia Polytechnic Institute in June 1956; Irwin Miller, F. S. McFeely, R. G. Cornell, T. S. Russell, D. E. W. Schumann, and H. C. Sweeny. Dr. Miller accepted a position with United States Steel in Monroeville, Pennsylvania; Dr. McFeely went with the University of Colorado in Denver, Colorado; Dr. Cornell is now with the Department of Health in Atlanta, Georgia; Dr. Russell resigned his position as Assistant Professor in the Department of Statistics of the Virginia Polytechnic Institute to accept a position with Washington State College in Pullman, Washington; Dr. Schumann returned to South Africa where he is now Head of the Department of Statistics at the University of Stellenbosch, Stellenbosch, South Africa; Dr. Sweeny has accepted a position with Atlantic Refinery in Philadelphia, Pennsylvania.

Mr. E. N. Fiske received his M. S. degree in statistics from the Virginia Polytechnic Institute in June 1956 and is now with North American Aircraft in Columbus, Ohio.

Mr. C. C. Beazley received his M. S. degree in statistics from the Virginia Polytechnic Institute in June 1956 and is now with General Foods Corporation in New Brunswick, New Jersey.

Mr. Paul D. Minton has returned to Southern Methodist University after spending one year with the Department of Statistics of the Virginia Polytechnic Institute.

Mr. M. C. K. Tweedie resigned his position as Associate Professor of Statistics at the Virginia Polytechnic Institute to accept a position with the University of Manchester, Manchester, England.

Mr. C. W. Clunies Ross has joined the staff of the Department of Statistics of the Virginia Polytechnic Institute as an Associate Professor. Mr. Clunies-Ross received a B. A. degree in mathematics from Cambridge University, England, in 1955 and a Diploma in Mathematical Statistics from Cambridge University in 1956. While at Cambridge, Mr. Clunies-Ross studied under an Open Scholarship. He is now working under a grant from the National Science Foundation.

Mr. A. E. Garratt has joined the staff of the Department of Statistics of the Virginia Polytechnic Institute as an Assistant Professor. Mr. Garratt received an A. B. degree in mathematics from the University of Nebraska in 1948 and an M. S. degree in mathematics from Northwestern University in 1950. Before coming to the Virginia Polytechnic Institute, Mr. Garratt worked at Dugway Proving Ground, Utah, as Chief of the Design and Analysis Office. He is now working under a contract with the National Advisory Committee for Aeronautics.

Dr. R. A. Bradley of the Virginia Polytechnic Institute received the Brumbaugh Award of the American Society for Quality Control for his paper, "Some Notes on the Theory and Application of Rank Order Statistics," presented at the Annual Convention in June 1956 in Montreal, Canada.

Dr. R. A. Bradley presented a paper entitled "Some Recent Research in Statistical Problems in Subjective Testing" at the Gordon Research-Conference in New Hampton, New Hampshire on "Statistics in Chemistry and Chemical Engineering," August 1956.

Dr. Boyd Harshbarger and Dr. R. A. Bradley attended the Second Conference on the Design of Experiments in Army Research, Development, and Testing at the National Bureau of Standards in October 1956. Both presented papers at this conference.

Mr. C. Y. Kramer and Dr. R. A. Bradley attended a Symposium on the Design of Industrial Experiments at the University of North Carolina in November 1956.

"The Introduction of Risk into a Programming Model" by Rudolf J. Freund appeared in Econometrica, 24, No. 3, July 1956.

The following papers by C. Y. Kramer: appeared recently in journals, "Extension of Multiple Range Tests to Group Means with Unequal Numbers of Replications," *Biometrics*, September 1956; "Additional Tables for a Method of Choosing Judges for a Sensory Experiment," *Food Research*, Sept.-Oct., 1956.

The following papers have appeared recently: "Some Results on Restricted Occupancy Theory," by J. E. Freund and A. N. Pozner, *Annals of Mathematical Statistics*; "Expected Arc Length of a Gaussian Process on a Finite Interval," I. Miller and J. E. Freund, *Journal of the Royal Statistical Society;* "Some Results on the Analysis of Random Signals by Means of a Cut-Counting Process," by I. Miller and J. E. Freund, *Journal of Applied Physics.*

The Southern Regional Graduate Summer Session in Statistics will be held at the Virginia Polytechnic Institute during the summer of 1957. Guest lecturers will be Dr. D. B. DeLury of the Ontario Foundation, Canada, and Dr. E. J. Williams of South Melbourne, Australia.

Dr. Boyd Harshbarger, who is Chairman of the Committee on Statistics of the Southern Regional Education Board, attended a meeting of that committee October 28 and 29 in New Orleans. Final plans for the 1957 and 1958 summer sessions were formalized at that time.

Dr. Norbert Lloyd Enrick, head of the Statistics Department, Institute of Textile Technology, Charlottesville, Virginia was appointed chairman of the ASTM Task Group on Electronic Yarn Imperfection Counters. Revisions were also made of the Method of Test for Unevenness of Textile Strands, under a separate Task Group of which he is also chairman.

The ASTM Manual on "Statistical Methods for Textile Technologists" is now nearing completion. Dr. Enrick is in charge of the sections on Sampling and Significance Tests for Sample Averages and Standard Deviations.

During the summer, Dr. Enrick presented a series of talks on statistical quality control applications before textile mill groups in Georgia and the Carolinas. On November 2, he presented a seminar at the Department of Statistics of the Virginia Polytechnic Institute. — PAUL N. SOMERVILLE, *National Bureau of Standards.*

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